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Depth, Velocity and Substrate Measurements of Pacific Salmon Habitat at Three Streamflows in Kloiya Creek, B.C. 1984-1985

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ABSTRACT

Bravender, B. A. and C. S. Shirvell. 1989. Depth, velocity and substrate measurements of Pacific salmon habitat at three streamflows in Kloiya Creek, B.C. 1984-1985. Can. Data Rep. Fish. Aquat. Sci. 758: 67 p.

The availability of juvenile coho and chinook salmon habitat was studied in Kloiya Creek, B.C. under three experimentally controlled streamflows. The three streamflows studied were 0.555-0.570 $m^3 \cdot s^{-1}$ (low), 1.11-1.17 $m^3 \cdot s^{-1}$ (medium) and 3.74-20.83 $m^3 \cdot s^{-1}$ (high). Hydrological data, commonly used in fish habitat models, was collected along twenty transects in five pools of the study area. The area of streambed characterized by intervals of water depth (cm) and velocity ($cm \cdot s^{-1}$) at 6/10 depth and 8 cm from the bottom was calculated. Substrate type was classified into fifteen categories and the area of each category was calculated. The data for each streamflow is reported here.

RÉSUMÉ

Bravender, B. A. and C. S. Shirvell. 1989. Depth, velocity and substrate measurements of Pacific salmon habitat at three streamflows in Kloiya Creek, B.C. 1984-1985. Can. Data Rep. Fish. Aquat. Sci. 758: 67 p.

Le ruisseau Kloiya (Colombie-Britannique) a été étudié pour déterminer s'il comptait des habitats pour les saumons coho et les saumons chinook juvéniles dans trois conditions expérimentales d'écoulement, à savoir 0,555-0,570 $m^3 \cdot s^{-1}$ (écoulement faible), 1,11-1,17 $m^3 \cdot s^{-1}$ (écoulement moyen) et 3,74-20,83 $m^3 \cdot s^{-1}$ (écoulement élevé). Des données hydrologiques, couramment utilisées dans les modèles d'habitats de poissons, ont été recueillies le long de 20 transects dans 5 mouilles de l'aire étudiée. On a mesuré la surface du lit du cours d'eau caractérisée par des intervalles de profondeur d'eau (cm) et la vitesse ($cm \cdot s^{-1}$) à une profondeur de 6/10 et à 8 cm du fond. Les types de substrats ont été classés en 15 catégories et la surface de chaque catégorie de substrat a été calculée. Les données ayant trait à chacun des écoulements sont présentées dans le présent article.

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INTRODUCTION

There are 1454 streams and rivers in British Columbia in which populations of coho (Oncorhynchus kisutch) salmon have been recorded and 482 in which runs of chinook salmon (Oncorhynchus tshawytscha) have been seen since 1953 (G. Serbic, pers. comm.). Many of these systems have also had the natural flow regime altered by the construction of dams to form reservoirs. There are now 1024 dams on salmon producing streams in B.C. alone (G. Ennis, pers. comm.). Many of these dams were built to generate hydroelectric power or store water for municipal or industrial use. Below these dams, the effect of the altered flow can range from scouring of the streambed and flooding of surrounding vegetation to extrememly low water levels which strand fish and eggs and disrupt the usual pool and riffle sequence.

To assess the effects of streamflow alteration on juvenile Pacific salmon habitat, a study was carried out on Kloiya Creek, British Columbia during 1984-85. This stream, about 2 km long, is part of a small coastal system located approximately 15 km southeast of Prince Rupert in an area which receives an average of 2855 mm of rainfall annually (Fig. 1). The drainage area is about 125 km^2 and includes four lakes. Between 1951 and 1961, three of these lakes (Taylor, Rainbow and Diana) were impounded to store water for a local pulp mill. These dams regulate the water level in both Kloiya and Diana Creeks. Water is released when the reservoir levels rise and held back when the levels fall. Between 1972-1982 discharge varied from 0.130 $m^3 \cdot s^{-1}$ to 94.3 $m^3 \cdot s^{-1}$. Maximum streamflows usually occur in October and minimum streamflows in August.

Escapement figures recorded between 1947-1982 indicate that an average of 5000 salmon spawn in this system annually, including sockeye (Oncorhynchus nerka, 3248), chum (Oncorhynchus keta, 160), chinook (437), coho (1465) and pink (Oncorhynchus gorbuscha, 1145). The juveniles of the coho and chinook salmon remain in Kloiya Creek, mainly in the pool habitats, for varying periods of time before migrating to sea. In conjunction with a study on the movements of these juvenile fish under varying flow conditions, the physical parameters of five pools in the stream were measured. The physical data is reported here. The microhabitat requirements and movements of the juvenile salmon will be reported elsewhere.

MATERIALS AND METHODS

In order to investigate the hydrological changes in the five pools of this creek, three different streamflow levels were artificially created by altering the level of the dam on the river. A gauge installed by the Water Survey of Canada (Station No. 08EG016) was used to adjust the depth of the creek to 53-54 cm (0.555-0.570 $m^3 \cdot s^{-1}$) (low), 58-59 cm (1.11-1.17 $m^3 \cdot s^{-1}$) (medium) and 71-113 cm (3.74-20.83 $m^3 \cdot s^{-1}$) (high).

Constant flow conditions could be maintained for varying periods of time, depending on the water level in the reservoir. Due to the capacity of the storage area, the data for the low and high streamflows had to be collected over different time periods to allow the reservoir to recover. The study section consisted of a 500 m stretch of river, containing five pools of different sizes separated by riffles. Hydrology measurements were taken along five transects crossing each pool, one at the top and bottom end of each pool and three others at 1/4, 1/2 and 3/4's of the way along each pool. The transects marking the top and bottom of each pool were placed on top of the hydraulic controls while the other transects were placed perpendicular to the streamflow at each location.

At each streamflow, water depth (cm) and water velocity ($cm \cdot s^{-1}$) were measured every meter along the transects. Substrate was classified into fifteen categories (silt, sand, gravel, etc.) and mapped at the lowest streamflow beyond the highest water mark on the banks. Only the dominant particle sizes according to the Modified Wentworth Particle Size Scale were recorded every meter along the transects. Water velocity was measured with a Marsh-McBirney current meter at 6/10 of the depth from the surface and at 8 cm above the streambed.

In the laboratory, the data was recorded on scale maps and isopleths were drawn. Contour intervals of 10.0 cm were used for depth and 15.0 $cm \cdot s^{-1}$ intervals for velocity. An Apple 11E graphics tablet was used to measure the area of each contour interval at each streamflow. The total area (m^2) and percentage area of each contour for each pool were then calculated by streamflow.

RESULTS

The lengths of each transect and the distances between them (m) are illustrated in figures 2-3. Table 1 lists the discharge rates by date for each flow level. Table 2 presents the area (m^2) of the water depth intervals by pool at the low, medium and high flow. The percent of the total area of each pool comprised by each depth interval is also included (Fig. 4, 5, 10, 11, 16, 17). The area and percent of total area of each velocity interval at 6/10 depth are listed in Table 3 by pool and flow level (Fig. 6, 7, 12, 13, 18, 19). The velocity intervals recorded at 8 cm from the bottom may be found in Table 4 (Fig. 8, 9, 14, 15, 20, 21).

The total area of each water depth interval for all five pools combined is presented in Table 5. The total area of the velocity intervals at 6/10 depth and at 8 cm from the bottom for all five pools combined are listed in Tables 6 and 7.

Comparisons of the different contour intervals for depth and velocity by pool are presented in Tables 8, 9 and 10. Table 11 lists the fifteen substrate types and their size ranges and Table 12 the areas of the dominant substrate types for all five pools at low flow (Fig. 22-23). The total area of each pool and all five pools combined for the three flow levels may be found in Table 13. The changes in the total area of each pool and all pools combined for the three flow levels are listed in Table 14.

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Table 1. Kloiya Creek hydrology study 1984-85. Discharge rates ($m^3 \cdot s^{-1}$) at low, medium and high flow.

Date	Flow Level	Gauge Height (m)	Discharge ($m^3 \cdot s^{-1}$)
Nov 28/84	Low	0.535	0.555
Nov 29/84	Low	0.540	0.570
June 24/85	Medium	0.585	1.11
June 25/85	Medium	0.590	1.17
Dec 12/84	High	1.125	20.83
Dec 13/84	High	0.720	3.87
Mar 1/85	High	0.715	3.74
Mar 2/85	High	0.775	5.53

Table 2. Kloiya Creek hydrology study 1984-1985. Area of water depth intervals by pool at low, medium and high flow.

Day	Mon	Year	Pool No.	Flow Level	Depth (cm)	Area (m^2)	Percent Area
28	Nov	84	1	Low	0- 9.9	103.63	21.08
28	Nov	84	1	Low	10- 19.9	186.49	37.94
28	Nov	84	1	Low	20- 29.9	112.94	22.97
28	Nov	84	1	Low	30- 39.9	58.38	11.88
28	Nov	84	1	Low	40- 49.9	17.90	3.64
28	Nov	84	1	Low	50- 59.9	8.64	1.76
28	Nov	84	1	Low	60- 69.9	3.61	0.73
29	Nov	84	2	Low	0- 9.9	214.69	24.41
29	Nov	84	2	Low	10- 19.9	168.73	19.18
29	Nov	84	2	Low	20- 29.9	127.93	14.55
29	Nov	84	2	Low	30- 39.9	109.74	12.48
29	Nov	84	2	Low	40- 49.9	69.46	7.90
29	Nov	84	2	Low	50- 59.9	91.65	10.42
29	Nov	84	2	Low	60- 69.9	50.30	5.72
29	Nov	84	2	Low	70- 79.9	20.07	2.28
29	Nov	84	2	Low	80- 89.9	24.76	2.82
29	Nov	84	2	Low	90- 99.9	2.18	0.25
29	Nov	84	3	Low	0- 9.9	83.81	23.62
29	Nov	84	3	Low	10- 19.9	93.66	26.40
29	Nov	84	3	Low	20- 29.9	45.09	12.71
29	Nov	84	3	Low	30- 39.9	57.82	16.30
29	Nov	84	3	Low	40- 49.9	41.74	11.77
29	Nov	84	3	Low	50- 59.9	21.07	5.94
29	Nov	84	3	Low	60- 69.9	8.34	2.35
29	Nov	84	3	Low	70- 79.9	3.23	0.91
29	Nov	84	4	Low	0- 9.9	133.58	63.18
29	Nov	84	4	Low	10- 19.9	70.97	33.57
29	Nov	84	4	Low	20- 29.9	6.87	3.25
29	Nov	84	5	Low	0- 9.9	182.88	39.71
29	Nov	84	5	Low	10- 19.9	171.39	37.22
29	Nov	84	5	Low	20- 29.9	92.23	20.03
29	Nov	84	5	Low	30- 39.9	12.70	2.76
29	Nov	84	5	Low	40- 49.9	1.31	0.28
24	Jun	85	1	Medium	0- 9.9	118.99	21.62
24	Jun	85	1	Medium	10- 19.9	112.51	20.44
24	Jun	85	1	Medium	20- 29.9	97.99	17.80
24	Jun	85	1	Medium	30- 39.9	127.76	23.21
24	Jun	85	1	Medium	40- 49.9	65.85	11.96
24	Jun	85	1	Medium	50- 59.9	15.07	2.74
24	Jun	85	1	Medium	60- 69.9	8.99	1.63
24	Jun	85	1	Medium	70- 79.9	3.20	0.58
24	Jun	85	2	Medium	0- 9.9	227.72	23.72
24	Jun	85	2	Medium	10- 19.9	123.44	12.86

Table 2 (cont'd)

Day	Mon	Year	Pool No.	Flow Level	Depth (cm)	Area (m^2)	Percent Area
24	Jun	85	2	Medium	20- 29.9	170.90	17.80
24	Jun	85	2	Medium	30- 39.9	117.35	12.22
24	Jun	85	2	Medium	40- 49.9	87.96	9.16
24	Jun	85	2	Medium	50- 59.9	79.49	8.28
24	Jun	85	2	Medium	60- 69.9	58.97	6.14
24	Jun	85	2	Medium	70- 79.9	60.07	6.26
24	Jun	85	2	Medium	80- 89.9	20.64	2.15
24	Jun	85	2	Medium	90- 99.9	13.53	1.41
25	Jun	85	3	Medium	0- 9.9	78.72	18.69
25	Jun	85	3	Medium	10- 19.9	54.76	13.00
25	Jun	85	3	Medium	20- 29.9	87.73	20.83
25	Jun	85	3	Medium	30- 39.9	77.89	18.49
25	Jun	85	3	Medium	40- 49.9	63.87	15.16
25	Jun	85	3	Medium	50- 59.9	45.85	10.89
25	Jun	85	3	Medium	60- 69.9	4.73	1.12
25	Jun	85	3	Medium	70- 79.9	4.66	1.11
25	Jun	85	3	Medium	80- 89.9	3.01	0.71
25	Jun	85	4	Medium	0- 9.9	94.74	34.04
25	Jun	85	4	Medium	10- 19.9	124.73	44.82
25	Jun	85	4	Medium	20- 29.9	45.67	16.41
25	Jun	85	4	Medium	30- 39.9	13.18	4.74
25	Jun	85	5	Medium	0- 9.9	78.43	15.86
25	Jun	85	5	Medium	10- 19.9	137.24	27.76
25	Jun	85	5	Medium	20- 29.9	156.54	31.66
25	Jun	85	5	Medium	30- 39.9	109.26	22.10
25	Jun	85	5	Medium	40- 49.9	11.74	2.37
25	Jun	85	5	Medium	50- 59.9	1.21	0.24
12	Dec	84	1	High	0- 9.9	98.52	15.75
12	Dec	84	1	High	10- 19.9	91.67	14.65
12	Dec	84	1	High	20- 29.9	76.81	12.28
12	Dec	84	1	High	30- 39.9	111.38	17.80
12	Dec	84	1	High	40- 49.9	115.11	18.40
12	Dec	84	1	High	50- 59.9	74.11	11.85
12	Dec	84	1	High	60- 69.9	39.81	6.36
12	Dec	84	1	High	70- 79.9	11.39	1.82
12	Dec	84	1	High	80- 89.9	6.81	1.09
13	Dec	84	2	High	0- 9.9	169.90	14.15
13	Dec	84	2	High	10- 19.9	236.78	19.73
13	Dec	84	2	High	20- 29.9	172.51	14.37
13	Dec	84	2	High	30- 39.9	183.15	15.26
13	Dec	84	2	High	40- 49.9	107.49	8.96
13	Dec	84	2	High	50- 59.9	72.32	6.03
13	Dec	84	2	High	60- 69.9	98.54	8.21

Table 2 (cont'd)

Day	Mon	Year	Pool No.	Flow Level	Depth (cm)	Area (m^2)	Percent Area
13	Dec	84	2	High	70- 79.9	69.58	5.80
13	Dec	84	2	High	80- 89.9	49.13	4.09
13	Dec	84	2	High	90- 99.9	29.20	2.43
13	Dec	84	2	High	100-109.9	11.72	0.98
1	Mar	85	3	High	0- 9.9	42.86	8.19
1	Mar	85	3	High	10- 19.9	99.71	19.05
1	Mar	85	3	High	20- 29.9	52.59	10.05
1	Mar	85	3	High	30- 39.9	78.32	14.97
1	Mar	85	3	High	40- 49.9	75.10	14.35
1	Mar	85	3	High	50- 59.9	64.65	12.35
1	Mar	85	3	High	60- 69.9	64.67	12.36
1	Mar	85	3	High	70- 79.9	30.86	5.90
1	Mar	85	3	High	80- 89.9	5.06	0.97
1	Mar	85	3	High	90- 99.9	8.91	1.70
1	Mar	85	3	High	100-109.9	0.58	0.11
1	Mar	85	4	High	0- 9.9	13.45	4.51
1	Mar	85	4	High	10- 19.9	65.43	21.94
1	Mar	85	4	High	20- 29.9	95.01	31.87
1	Mar	85	4	High	30- 39.9	103.75	34.80
1	Mar	85	4	High	40- 49.9	20.52	6.88
2	Mar	85	5	High	0- 9.9	40.52	7.73
2	Mar	85	5	High	10- 19.9	67.71	12.91
2	Mar	85	5	High	20- 29.9	80.99	15.45
2	Mar	85	5	High	30- 39.9	200.50	38.24
2	Mar	85	5	High	40- 49.9	129.18	24.64
2	Mar	85	5	High	50- 59.9	4.30	0.82
2	Mar	85	5	High	60- 69.9	1.13	0.22

Table 3. Kloiya Creek hydrology study 1984-1985. Area of velocity intervals by pool at 6/10 depth at low, medium and high flow.

Day	Mon	Year	Pool No.	Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Area
28	Nov	84	1	Low	0- 14.9	222.19	45.20
28	Nov	84	1	Low	15- 29.9	232.24	47.24
28	Nov	84	1	Low	30- 44.9	32.30	6.57
28	Nov	84	1	Low	45- 59.9	4.86	0.99
29	Nov	84	2	Low	0- 14.9	646.02	73.45
29	Nov	84	2	Low	15- 29.9	210.53	23.94
29	Nov	84	2	Low	30- 44.9	21.43	2.44
29	Nov	84	2	Low	45- 59.9	1.53	0.17
29	Nov	84	3	Low	0- 14.9	66.52	18.75
29	Nov	84	3	Low	15- 29.9	56.62	15.96
29	Nov	84	3	Low	30- 44.9	150.26	42.36
29	Nov	84	3	Low	45- 59.9	38.57	10.87
29	Nov	84	3	Low	60- 74.9	37.84	10.67
29	Nov	84	3	Low	75- 89.9	4.95	1.40
29	Nov	84	4	Low	0- 14.9	30.26	14.31
29	Nov	84	4	Low	15- 29.9	15.22	7.20
29	Nov	84	4	Low	30- 44.9	40.49	19.15
29	Nov	84	4	Low	45- 59.9	66.07	31.25
29	Nov	84	4	Low	60- 74.9	51.25	24.24
29	Nov	84	4	Low	75- 89.9	8.13	3.85
29	Nov	84	5	Low	0- 14.9	69.40	15.07
29	Nov	84	5	Low	15- 29.9	79.21	17.20
29	Nov	84	5	Low	30- 44.9	199.44	43.31
29	Nov	84	5	Low	45- 59.9	87.94	19.10
29	Nov	84	5	Low	60- 74.9	24.52	5.32
24	Jun	85	1	Medium	0- 14.9	224.81	40.85
24	Jun	85	1	Medium	15- 29.9	111.25	20.21
24	Jun	85	1	Medium	30- 44.9	172.19	31.29
24	Jun	85	1	Medium	45- 59.9	27.60	5.01
24	Jun	85	1	Medium	60- 74.9	11.93	2.17
24	Jun	85	1	Medium	75- 89.9	2.58	0.47
24	Jun	85	2	Medium	0- 14.9	500.72	52.15
24	Jun	85	2	Medium	15- 29.9	311.32	32.43
24	Jun	85	2	Medium	30- 44.9	144.19	15.02
24	Jun	85	2	Medium	45- 59.9	3.84	0.40
25	Jun	85	3	Medium	0- 14.9	141.97	33.70
25	Jun	85	3	Medium	15- 29.9	130.88	31.07
25	Jun	85	3	Medium	30- 44.9	84.03	19.95
25	Jun	85	3	Medium	45- 59.9	53.09	12.60
25	Jun	85	3	Medium	60- 74.9	11.25	2.67
25	Jun	85	4	Medium	0- 14.9	54.92	19.73
25	Jun	85	4	Medium	15- 29.9	24.82	8.92
25	Jun	85	4	Medium	30- 44.9	85.18	30.61

Table 3 (cont'd)

Day	Mon	Year	Pool No.	Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Area
25	Jun	85	4	Medium	45- 59.9	64.06	23.02
25	Jun	85	4	Medium	60- 74.9	49.34	17.73
25	Jun	85	5	Medium	0- 14.9	90.56	18.32
25	Jun	85	5	Medium	15- 29.9	131.94	26.69
25	Jun	85	5	Medium	30- 44.9	183.23	37.06
25	Jun	85	5	Medium	45- 59.9	80.90	16.36
25	Jun	85	5	Medium	60- 74.9	7.79	1.58
12	Dec	84	1	High	0- 14.9	191.24	30.57
12	Dec	84	1	High	15- 29.9	52.57	8.40
12	Dec	84	1	High	30- 44.9	46.95	7.50
12	Dec	84	1	High	45- 59.9	65.71	10.50
12	Dec	84	1	High	60- 74.9	132.64	21.20
12	Dec	84	1	High	75- 89.9	83.85	13.40
12	Dec	84	1	High	90-104.9	47.52	7.60
12	Dec	84	1	High	105-119.9	5.13	0.82
13	Dec	84	2	High	0- 14.9	324.34	27.02
13	Dec	84	2	High	15- 29.9	173.37	14.44
13	Dec	84	2	High	30- 44.9	259.97	21.66
13	Dec	84	2	High	45- 59.9	197.91	16.49
13	Dec	84	2	High	60- 74.9	206.93	17.24
13	Dec	84	2	High	75- 89.9	37.80	3.15
1	Mar	85	3	High	0- 14.9	32.56	6.22
1	Mar	85	3	High	15- 29.9	33.10	6.33
1	Mar	85	3	High	30- 44.9	98.25	18.77
1	Mar	85	3	High	45- 59.9	138.99	26.56
1	Mar	85	3	High	60- 74.9	90.92	17.37
1	Mar	85	3	High	75- 89.9	54.35	10.39
1	Mar	85	3	High	90-104.9	52.59	10.05
1	Mar	85	3	High	105-119.9	20.03	3.83
1	Mar	85	3	High	120-134.9	2.52	0.48
1	Mar	85	4	High	0- 14.9	34.04	11.42
1	Mar	85	4	High	15- 29.9	14.40	4.83
1	Mar	85	4	High	30- 44.9	17.44	5.85
1	Mar	85	4	High	45- 59.9	58.39	19.58
1	Mar	85	4	High	60- 74.9	28.87	9.68
1	Mar	85	4	High	75- 89.9	39.40	13.21
1	Mar	85	4	High	90-104.9	77.63	26.04
1	Mar	85	4	High	105-119.9	23.70	7.95
1	Mar	85	4	High	120-134.9	4.29	1.44
2	Mar	85	5	High	0- 14.9	72.77	13.88
2	Mar	85	5	High	15- 29.9	45.79	8.73
2	Mar	85	5	High	30- 44.9	164.42	31.36
2	Mar	85	5	High	45- 59.9	165.67	31.60
2	Mar	85	5	High	60- 74.9	35.00	6.68
2	Mar	85	5	High	75- 89.9	28.28	5.39
2	Mar	85	5	High	90-104.9	12.28	2.34
2	Mar	85	5	High	105-119.9	0.12	0.02

Table 4. Kloiya Creek hydrology study 1984-1985. Area of velocity intervals by pool at 8 cm from the bottom at low, medium and high flow.

Day	Mon	Year	Pool No.	Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Area
28	Nov	84	1	Low	0- 14.9	286.86	58.35
28	Nov	84	1	Low	15- 29.9	152.32	31.00
28	Nov	84	1	Low	30- 44.9	35.89	7.30
28	Nov	84	1	Low	45- 59.9	16.52	3.36
29	Nov	84	2	Low	0- 14.9	755.80	85.93
29	Nov	84	2	Low	15- 29.9	114.65	13.04
29	Nov	84	2	Low	30- 44.9	7.67	0.87
29	Nov	84	2	Low	45- 59.9	1.39	0.16
29	Nov	84	3	Low	0- 14.9	185.41	52.26
29	Nov	84	3	Low	15- 29.9	117.56	33.14
29	Nov	84	3	Low	30- 44.9	38.17	10.76
29	Nov	84	3	Low	45- 59.9	10.89	3.07
29	Nov	84	3	Low	60- 74.9	2.73	0.77
29	Nov	84	4	Low	0- 14.9	48.21	22.80
29	Nov	84	4	Low	15- 29.9	52.44	24.80
29	Nov	84	4	Low	30- 44.9	62.79	29.70
29	Nov	84	4	Low	45- 59.9	38.09	18.02
29	Nov	84	4	Low	60- 74.9	9.89	4.68
29	Nov	84	5	Low	0- 14.9	144.95	31.48
29	Nov	84	5	Low	15- 29.9	165.58	35.96
29	Nov	84	5	Low	30- 44.9	136.45	29.63
29	Nov	84	5	Low	45- 59.9	13.53	2.94
24	Jun	85	1	Medium	0- 14.9	207.57	37.72
24	Jun	85	1	Medium	15- 29.9	211.46	38.42
24	Jun	85	1	Medium	30- 44.9	112.24	20.39
24	Jun	85	1	Medium	45- 59.9	16.16	2.94
24	Jun	85	1	Medium	60- 74.9	2.93	0.53
24	Jun	85	2	Medium	0- 14.9	534.25	55.65
24	Jun	85	2	Medium	15- 29.9	326.15	33.97
24	Jun	85	2	Medium	30- 44.9	93.17	9.70
24	Jun	85	2	Medium	45- 59.9	6.24	0.65
24	Jun	85	2	Medium	60- 74.9	0.26	0.03
25	Jun	85	3	Medium	0- 14.9	174.15	41.34
25	Jun	85	3	Medium	15- 29.9	141.89	33.69
25	Jun	85	3	Medium	30- 44.9	69.47	16.49
25	Jun	85	3	Medium	45- 59.9	26.36	6.26
25	Jun	85	3	Medium	60- 74.9	4.28	1.02

Table 4 (cont'd)

Day	Mon	Year	Pool No.	Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Area
25	Jun	85	3	Medium	75- 89.9	5.07	1.20
25	Jun	85	4	Medium	0- 14.9	85.35	30.67
25	Jun	85	4	Medium	15- 29.9	34.76	12.49
25	Jun	85	4	Medium	30- 44.9	52.41	18.83
25	Jun	85	4	Medium	45- 59.9	72.12	25.91
25	Jun	85	4	Medium	60- 74.9	33.68	12.10
25	Jun	85	5	Medium	0- 14.9	97.16	19.65
25	Jun	85	5	Medium	15- 29.9	170.90	34.57
25	Jun	85	5	Medium	30- 44.9	117.67	23.80
25	Jun	85	5	Medium	45- 59.9	98.00	19.82
25	Jun	85	5	Medium	60- 74.9	10.69	2.16
12	Dec	84	1	High	0- 14.9	211.50	33.81
12	Dec	84	1	High	15- 29.9	55.94	8.94
12	Dec	84	1	High	30- 44.9	88.70	14.18
12	Dec	84	1	High	45- 59.9	171.37	27.39
12	Dec	84	1	High	60- 74.9	71.72	11.46
12	Dec	84	1	High	75- 89.9	25.94	4.15
12	Dec	84	1	High	90-104.9	0.44	0.07
13	Dec	84	2	High	0- 14.9	391.28	32.60
13	Dec	84	2	High	15- 29.9	258.16	21.51
13	Dec	84	2	High	30- 44.9	194.63	16.21
13	Dec	84	2	High	45- 59.9	262.28	21.85
13	Dec	84	2	High	60- 74.9	62.85	5.24
13	Dec	84	2	High	75- 89.9	31.12	2.59
1	Mar	85	3	High	0- 14.9	72.01	13.76
1	Mar	85	3	High	15- 29.9	47.80	9.13
1	Mar	85	3	High	30- 44.9	231.01	44.14
1	Mar	85	3	High	45- 59.9	69.84	13.35
1	Mar	85	3	High	60- 74.9	45.33	8.66
1	Mar	85	3	High	75- 89.9	39.80	7.61
1	Mar	85	3	High	90-104.9	10.97	2.10
1	Mar	85	3	High	105-119.9	6.25	1.19
1	Mar	85	3	High	120-134.9	0.30	0.06
1	Mar	85	4	High	0- 14.9	54.84	18.39
1	Mar	85	4	High	15- 29.9	11.31	3.79
1	Mar	85	4	High	30- 44.9	32.44	10.88
1	Mar	85	4	High	45- 59.9	50.10	16.80
1	Mar	85	4	High	60- 74.9	38.39	12.88
1	Mar	85	4	High	75- 89.9	47.03	15.77
1	Mar	85	4	High	90-104.9	25.73	8.63
1	Mar	85	4	High	105-119.9	37.08	12.44
1	Mar	85	4	High	120-134.9	1.24	0.42

Table 4 (cont'd)

Day	Mon	Year	Pool No.	Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Area
2	Mar	85	5	High	0- 14.9	65.14	12.42
2	Mar	85	5	High	15- 29.9	114.50	21.84
2	Mar	85	5	High	30- 44.9	233.16	44.47
2	Mar	85	5	High	45- 59.9	56.41	10.76
2	Mar	85	5	High	60- 74.9	36.72	7.00
2	Mar	85	5	High	75- 89.9	15.76	3.01
2	Mar	85	5	High	90-104.9	2.52	0.48
2	Mar	85	5	High	105-119.9	0.12	0.02

Table 5. Kloiya Creek hydrology study 1984-1985. Total area of water depth intervals in the five pools combined at low, medium and high flow.

Flow Level	Depth (cm)	Area (m^2)	Percent Total
Low	0- 9.9	718.59	29.97
Low	10- 19.9	691.24	28.83
Low	20- 29.9	385.06	16.06
Low	30- 39.9	238.64	9.95
Low	40- 49.9	130.41	5.44
Low	50- 59.9	121.36	5.06
Low	60- 69.9	62.25	2.60
Low	70- 79.9	23.30	0.97
Low	80- 89.9	24.76	1.03
Low	90- 99.9	2.18	0.09
Medium	0- 9.9	598.60	22.13
Medium	10- 19.9	552.68	20.44
Medium	20- 29.9	558.83	20.66
Medium	30- 39.9	445.44	16.47
Medium	40- 49.9	229.42	8.48
Medium	50- 59.9	141.62	5.24
Medium	60- 69.9	72.69	2.69
Medium	70- 79.9	67.93	2.51
Medium	80- 89.9	23.65	0.87
Medium	90- 99.9	13.53	0.50
High	0- 9.9	365.25	11.52
High	10- 19.9	561.30	17.70
High	20- 29.9	477.91	15.07
High	30- 39.9	677.10	21.35
High	40- 49.9	447.40	14.11
High	50- 59.9	215.38	6.79
High	60- 69.9	204.15	6.44
High	70- 79.9	111.83	3.53
High	80- 89.9	61.00	1.92
High	90- 99.9	38.11	1.20
High	100-109.9	12.30	0.39

Table 6. Kloiya Creek hydrology study 1984-1985. Total area of velocity intervals at 6/10 depth in the five pools combined at low, medium and high flow.

Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Total
Low	0- 14.9	1034.39	43.14
Low	15- 29.9	593.82	24.77
Low	30- 44.9	443.92	18.51
Low	45- 59.9	198.17	8.30
Low	60- 74.9	113.61	4.74
Low	75- 89.9	13.08	0.55
Medium	0- 14.9	1012.98	37.46
Medium	15- 29.9	710.21	26.26
Medium	30- 44.9	668.82	24.73
Medium	45- 59.9	229.49	8.49
Medium	60- 74.9	80.31	2.97
Medium	75- 89.9	2.58	0.10
High	0- 14.9	654.95	20.65
High	15- 29.9	319.23	10.06
High	30- 44.9	587.03	18.51
High	45- 59.9	626.67	19.76
High	60- 74.9	494.36	15.59
High	75- 89.9	243.68	7.68
High	90-104.9	190.02	5.99
High	105-119.9	48.98	1.54
High	120-134.9	6.81	0.21

Table 7. Kloiya Creek hydrology study 1984-1985. Total area of velocity intervals at 8 cm from the bottom in the five pools combined at low, medium and high flow.

Flow Level	Velocity ($cm \cdot s^{-1}$)	Area (m^2)	Percent Total
Low	0- 14.9	1421.23	59.27
Low	15- 29.9	602.55	25.13
Low	30- 44.9	280.97	11.72
Low	45- 59.9	80.42	3.35
Low	60- 74.9	12.62	0.53
Medium	0- 14.9	1098.48	40.62
Medium	15- 29.9	885.16	32.73
Medium	30- 44.9	444.96	16.45
Medium	45- 59.9	218.88	8.09
Medium	60- 74.9	51.84	1.92
Medium	75- 89.9	5.07	0.19
High	0- 14.9	794.77	25.06
High	15- 29.9	487.71	15.38
High	30- 44.9	779.94	24.59
High	45- 59.9	610.00	19.23
High	60- 74.9	255.01	8.04
High	75- 89.9	159.65	5.03
High	90-104.9	39.66	1.25
High	105-119.9	43.45	1.37
High	120-134.9	1.54	0.05

Table 8. Kloiya Creek hydrology study 1984-1985. Comparison of area of water depth intervals by pool at low (L), medium (M) and high (H) flow.

Pool No.	Depth (cm)	Area(L) (m^2)	Percent Area(L)	Area(M) (m^2)	Percent Area(M)	Area(H) (m^2)	Percent Area(H)
1	0- 9.9	103.63	21.08	118.99	21.62	98.52	15.75
1	10- 19.9	186.49	37.94	112.51	20.44	91.67	14.65
1	20- 29.9	112.94	22.97	97.99	17.80	76.81	12.28
1	30- 39.9	58.38	11.88	127.76	23.21	111.38	17.80
1	40- 49.9	17.90	3.64	65.85	11.96	115.11	18.40
1	50- 59.9	8.64	1.76	15.07	2.74	74.11	11.85
1	60- 69.9	3.61	0.73	8.99	1.63	39.81	6.36
1	70- 79.9	0.00	0.00	3.20	0.58	11.39	1.82
1	80- 89.9	0.00	0.00	0.00	0.00	6.81	1.09
2	0- 9.9	214.69	24.41	227.72	23.72	169.90	14.15
2	10- 19.9	168.73	19.18	123.44	12.86	236.78	19.73
2	20- 29.9	127.93	14.55	170.90	17.80	172.51	14.37
2	30- 39.9	109.74	12.48	117.35	12.22	183.15	15.26
2	40- 49.9	69.46	7.90	87.96	9.16	107.49	8.96
2	50- 59.9	91.65	10.42	79.49	8.28	72.32	6.03
2	60- 69.9	50.30	5.72	58.97	6.14	98.54	8.21
2	70- 79.9	20.07	2.28	60.07	6.26	69.58	5.80
2	80- 89.9	24.76	2.82	20.64	2.15	49.13	4.09
2	90- 99.9	2.18	0.25	13.53	1.41	29.20	2.43
2	100-109.9	0.00	0.00	0.00	0.00	11.72	0.98
3	0- 9.9	83.81	23.62	78.72	18.69	42.86	8.19
3	10- 19.9	93.66	26.40	54.76	13.00	99.71	19.05
3	20- 29.9	45.09	12.71	87.73	20.83	52.59	10.05
3	30- 39.9	57.82	16.30	77.89	18.49	78.32	14.97
3	40- 49.9	41.74	11.77	63.87	15.16	75.10	14.35
3	50- 59.9	21.07	5.94	45.85	10.89	64.65	12.35
3	60- 69.9	8.34	2.35	4.73	1.12	64.67	12.36
3	70- 79.9	3.23	0.91	4.66	1.11	30.86	5.90
3	80- 89.9	0.00	0.00	3.01	0.71	5.06	0.97
3	90- 99.9	0.00	0.00	0.00	0.00	8.91	1.70
3	100-109.9	0.00	0.00	0.00	0.00	0.58	0.11
4	0- 9.9	133.58	63.18	94.74	34.04	13.45	4.51
4	10- 19.9	70.97	33.57	124.73	44.82	65.43	21.94
4	20- 29.9	6.87	3.25	45.67	16.41	95.01	31.87
4	30- 39.9	0.00	0.00	13.18	4.74	103.75	34.80
4	40- 49.9	0.00	0.00	0.00	0.00	20.52	6.88
5	0- 9.9	182.88	39.71	78.43	15.86	40.52	7.73
5	10- 19.9	171.39	37.22	137.24	27.76	67.71	12.91
5	20- 29.9	92.23	20.03	156.54	31.66	80.99	15.45
5	30- 39.9	12.70	2.76	109.26	22.10	200.50	38.24
5	40- 49.9	1.31	0.28	11.74	2.37	129.18	24.64
5	50- 59.9	0.00	0.00	1.21	0.24	4.30	0.82
5	60- 69.9	0.00	0.00	0.00	0.00	1.13	0.22

Table 9. Kloiya Creek hydrology study 1984-1985. Comparison of area of velocity intervals by pool at 6/10 depth at low (L), medium (M) and high (H) flow.

Pool No.	Velocity ($cm \cdot s^{-1}$)	Area(L) (m^2)	Percent Area(L)	Area(M) (m^2)	Percent Area(M)	Area(H) (m^2)	Percent Area(H)
1	0- 14.9	222.19	45.20	224.81	40.85	191.24	30.57
1	15- 29.9	232.24	47.24	111.25	20.21	52.57	8.40
1	30- 44.9	32.30	6.57	172.19	31.29	46.95	7.50
1	45- 59.9	4.86	0.99	27.60	5.01	65.71	10.50
1	60- 74.9	0.00	0.00	11.93	2.17	132.64	21.20
1	75- 89.9	0.00	0.00	2.58	0.47	83.85	13.40
1	90-104.9	0.00	0.00	0.00	0.00	47.52	7.60
1	105-119.9	0.00	0.00	0.00	0.00	5.13	0.82
2	0- 14.9	646.02	73.45	500.72	52.15	324.34	27.02
2	15- 29.9	210.53	23.94	311.32	32.43	173.37	14.44
2	30- 44.9	21.43	2.44	144.19	15.02	259.97	21.66
2	45- 59.9	1.53	0.17	3.84	0.40	197.91	16.49
2	60- 74.9	0.00	0.00	0.00	0.00	206.93	17.24
2	75- 89.9	0.00	0.00	0.00	0.00	37.80	3.15
3	0- 14.9	66.52	18.75	141.97	33.70	32.56	6.22
3	15- 29.9	56.62	15.96	130.88	31.07	33.10	6.33
3	30- 44.9	150.26	42.36	84.03	19.95	98.25	18.77
3	45- 59.9	38.57	10.87	53.09	12.60	138.99	26.56
3	60- 74.9	37.84	10.67	11.25	2.67	90.92	17.37
3	75- 89.9	4.95	1.40	0.00	0.00	54.35	10.39
3	90-104.9	0.00	0.00	0.00	0.00	52.59	10.05
3	105-119.9	0.00	0.00	0.00	0.00	20.03	3.83
3	120-134.9	0.00	0.00	0.00	0.00	2.52	0.48
4	0- 14.9	30.26	14.31	54.92	19.73	34.04	11.42
4	15- 29.9	15.22	7.20	24.82	8.92	14.40	4.83
4	30- 44.9	40.49	19.15	85.18	30.61	17.44	5.85
4	45- 59.9	66.07	31.25	64.06	23.02	58.39	19.58
4	60- 74.9	51.25	24.24	49.34	17.73	28.87	9.68
4	75- 89.9	8.13	3.85	0.00	0.00	39.40	13.21
4	90-104.9	0.00	0.00	0.00	0.00	77.63	26.04
4	105-119.9	0.00	0.00	0.00	0.00	23.70	7.95
4	120-134.9	0.00	0.00	0.00	0.00	4.29	1.44
5	0- 14.9	69.40	15.07	90.56	18.32	72.77	13.88
5	15- 29.9	79.21	17.20	131.94	26.69	45.79	8.73
5	30- 44.9	199.44	43.31	183.23	37.06	164.42	31.36
5	45- 59.9	87.94	19.10	80.90	16.36	165.67	31.60
5	60- 74.9	24.52	5.32	7.79	1.58	35.00	6.68
5	75- 89.9	0.00	0.00	0.00	0.00	28.28	5.39
5	90-104.9	0.00	0.00	0.00	0.00	12.28	2.34
5	105-119.9	0.00	0.00	0.00	0.00	0.12	0.02

Table 10. Kloiya Creek hydrology study 1984-1985. Comparison of area of velocity intervals by pool at 8 cm from the bottom at low (L), medium (M) and high (H) flow.

Pool No.	Velocity ($cm \cdot s^{-1}$)	Area(L) (m^2)	Percent Area(L)	Area(M) (m^2)	Percent Area(M)	Area(H) (m^2)	Percent Area(H)
1	0- 14.9	286.86	58.35	207.57	37.72	211.50	33.81
1	15- 29.9	152.32	31.00	211.46	38.42	55.94	8.94
1	30- 44.9	35.89	7.30	112.24	20.39	88.70	14.18
1	45- 59.9	16.52	3.36	16.16	2.94	171.37	27.39
1	60- 74.9	0.00	0.00	2.93	0.53	71.72	11.46
1	75- 89.9	0.00	0.00	0.00	0.00	25.94	4.15
1	90-104.9	0.00	0.00	0.00	0.00	0.44	0.07
2	0- 14.9	755.80	85.93	534.25	55.65	391.28	32.60
2	15- 29.9	114.65	13.04	326.15	33.97	258.16	21.51
2	30- 44.9	7.67	0.87	93.17	9.70	194.63	16.21
2	45- 59.9	1.39	0.16	6.24	0.65	262.28	21.85
2	60- 74.9	0.00	0.00	0.26	0.03	62.85	5.24
2	75- 89.9	0.00	0.00	0.00	0.00	31.12	2.59
3	0- 14.9	185.41	52.26	174.15	41.34	72.01	13.76
3	15- 29.9	117.56	33.14	141.89	33.69	47.80	9.13
3	30- 44.9	38.17	10.76	69.47	16.49	231.01	44.14
3	45- 59.9	10.89	3.07	26.36	6.26	69.84	13.35
3	60- 74.9	2.73	0.77	4.28	1.02	45.33	8.66
3	75- 89.9	0.00	0.00	5.07	1.20	39.80	7.61
3	90-104.9	0.00	0.00	0.00	0.00	10.97	2.10
3	105-119.9	0.00	0.00	0.00	0.00	6.25	1.19
3	120-134.9	0.00	0.00	0.00	0.00	0.30	0.06
4	0- 14.9	48.21	22.80	85.35	30.67	54.84	18.39
4	15- 29.9	52.44	24.80	34.76	12.49	11.31	3.79
4	30- 44.9	62.79	29.70	52.41	18.83	32.44	10.88
4	45- 59.9	38.09	18.02	72.12	25.91	50.10	16.80
4	60- 74.9	9.89	4.68	33.68	12.10	38.39	12.88
4	75- 89.9	0.00	0.00	0.00	0.00	47.03	15.77
4	90-104.9	0.00	0.00	0.00	0.00	25.73	8.63
4	105-119.9	0.00	0.00	0.00	0.00	37.08	12.44
4	120-134.9	0.00	0.00	0.00	0.00	1.24	0.42
5	0- 14.9	144.95	31.48	97.16	19.65	65.14	12.42
5	15- 29.9	165.58	35.96	170.90	34.57	114.50	21.84
5	30- 44.9	136.45	29.63	117.67	23.80	233.16	44.47
5	45- 59.9	13.53	2.94	98.00	19.82	56.41	10.76
5	60- 74.9	0.00	0.00	10.69	2.16	36.72	7.00
5	75- 89.9	0.00	0.00	0.00	0.00	15.76	3.01
5	90-104.9	0.00	0.00	0.00	0.00	2.52	0.48
5	105-119.9	0.00	0.00	0.00	0.00	0.12	0.02

Table 11. Kloiya Creek hydrology study 1984-1985. Particle size scale of different substrate types in the five pools at low flow.

Substrate type	Size Range (mm)
Mammoth boulder	4000+
Very large boulder	2000 - 4000
Large boulder	1000 - 2000
Medium boulder	500 - 1000
Small boulder	250 - 500
Large cobble	130 - 250
Small cobble	64 - 130
Very coarse gravel	32 - 64
Coarse gravel	16 - 32
Medium gravel	8 - 16
Fine gravel	4 - 8
Pea gravel	2 - 4
Very coarse sand	1 - 2
Sand	.062 - 1
Silt - clay	.062

Table 12. Kloiya Creek hydrology study 1984-1985. Area of different substrate types in the five pools at low flow.

Day	Mon	Year	Pool No.	Substrate Type	Area (m^2)	Percent Area
28	Nov	84	1	Small cobble	225.50	45.87
28	Nov	84	1	Large cobble	264.84	53.87
28	Nov	84	1	Small boulder	1.25	0.25
29	Nov	84	2	Small cobble	310.82	35.34
29	Nov	84	2	Large cobble	568.34	64.62
29	Nov	84	2	Small boulder	0.35	0.04
29	Nov	84	3	Small cobble	45.09	12.71
29	Nov	84	3	Large cobble	309.67	87.29
29	Nov	84	4	Small cobble	113.34	53.61
29	Nov	84	4	Large cobble	96.87	45.82
29	Nov	84	4	Small boulder	1.21	0.57
29	Nov	84	5	Small cobble	66.81	14.51
29	Nov	84	5	Large cobble	331.64	72.02
29	Nov	84	5	Small boulder	3.52	0.76
29	Nov	84	5	Bedrock	58.54	12.71
			All	Small cobble	761.56	31.76
			All	Large cobble	1571.36	65.53
			All	Small boulder	6.33	0.26
			All	Bedrock	58.54	2.44

Table 13. Kloiya Creek hydrology study 1984-1985. Total area of each pool and all pools combined at low (L), medium (M) and high (H) flow.

Year	Pool No.	Area(L) (m^2)	Percent Area(L)	Area(M) (m^2)	Percent Area(M)	Area(H) (m^2)	Percent Area(H)
85	1	491.59	20.50	550.36	20.35	625.61	19.72
85	2	879.51	36.68	960.07	35.50	1200.32	37.84
85	3	354.76	14.80	421.22	15.58	523.31	16.50
85	4	211.42	8.82	278.32	10.29	298.16	9.40
85	5	460.51	19.20	494.42	18.28	524.33	16.53
85	All	2397.79	100.00	2704.39	100.00	3171.73	99.99

Table 14. Kloiya Creek hydrology study 1984-1985. Change in total area of each pool and all pools combined at low (L), medium (M) and high (H) flow.

Pool No.	Area(L) (m^2)	Area(M) (m^2)	Increase Area(L-M)	Percent Increase	Area(H) (m^2)	Increase Area(M-H)	Percent Increase
1	491.59	550.36	58.77	11.96	625.61	75.25	13.67
2	879.51	960.07	80.56	9.16	1200.32	240.25	25.02
3	354.76	421.22	66.46	18.73	523.31	102.09	24.24
4	211.42	278.32	66.90	31.64	298.16	19.84	7.13
5	460.51	494.42	33.91	7.36	524.33	29.91	6.05
All	2397.79	2704.39	306.60	12.79	3171.73	467.34	17.28

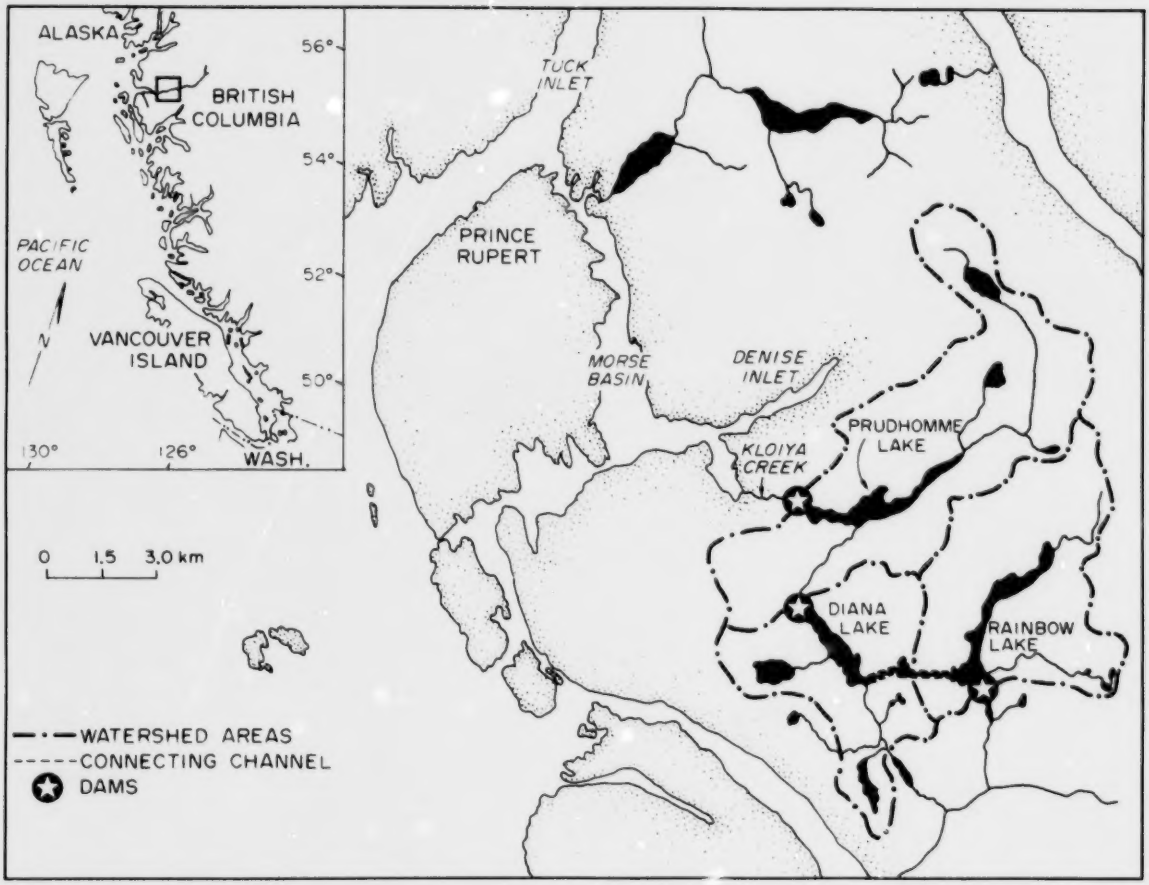

Fig. 1. Map of Kloiya Creek and the surrounding area showing the location of the study area.

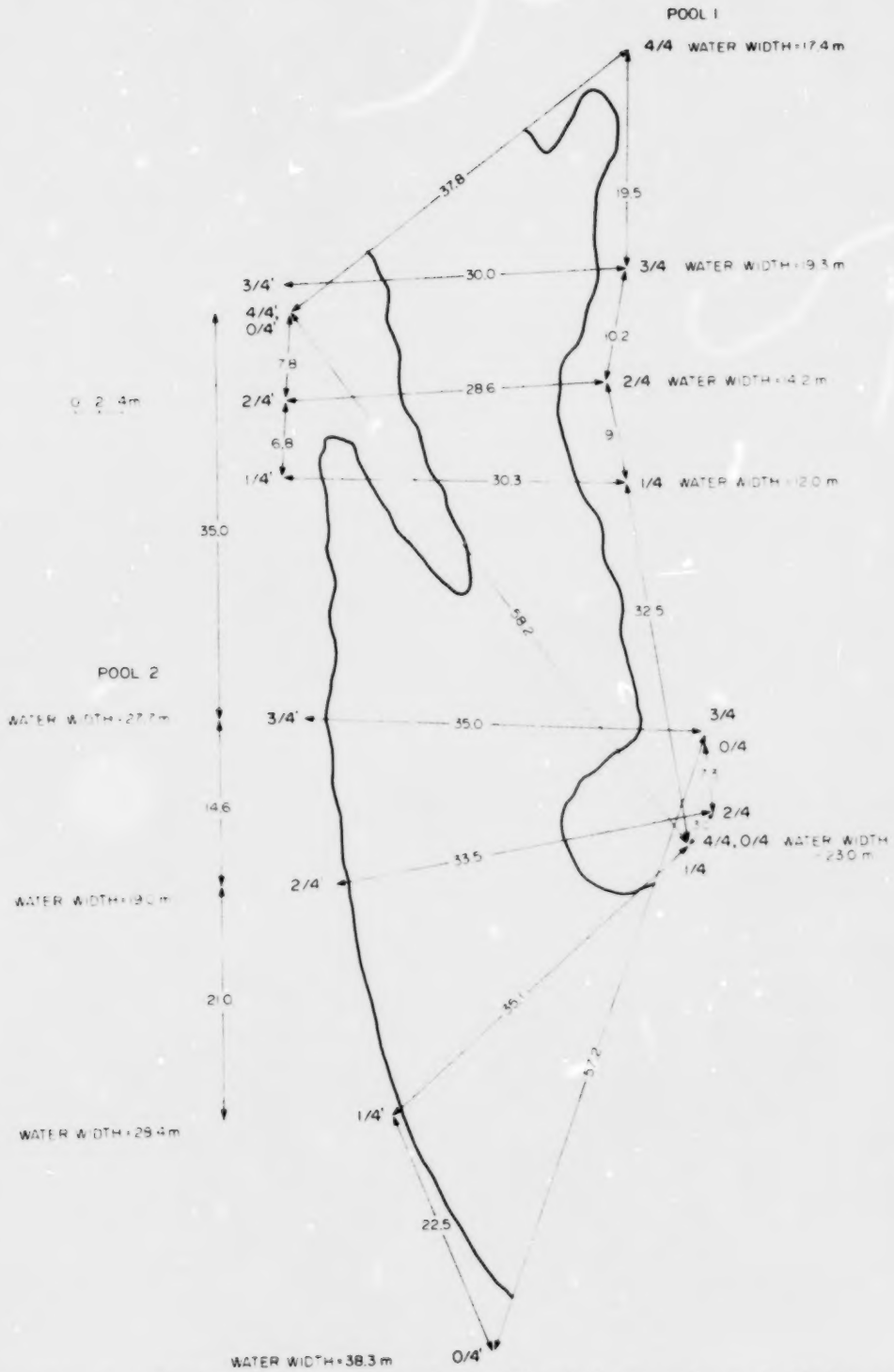

Fig. 2. Kloiya Creek. Map of length of transects and distances between them (m), pools 1 and 2.

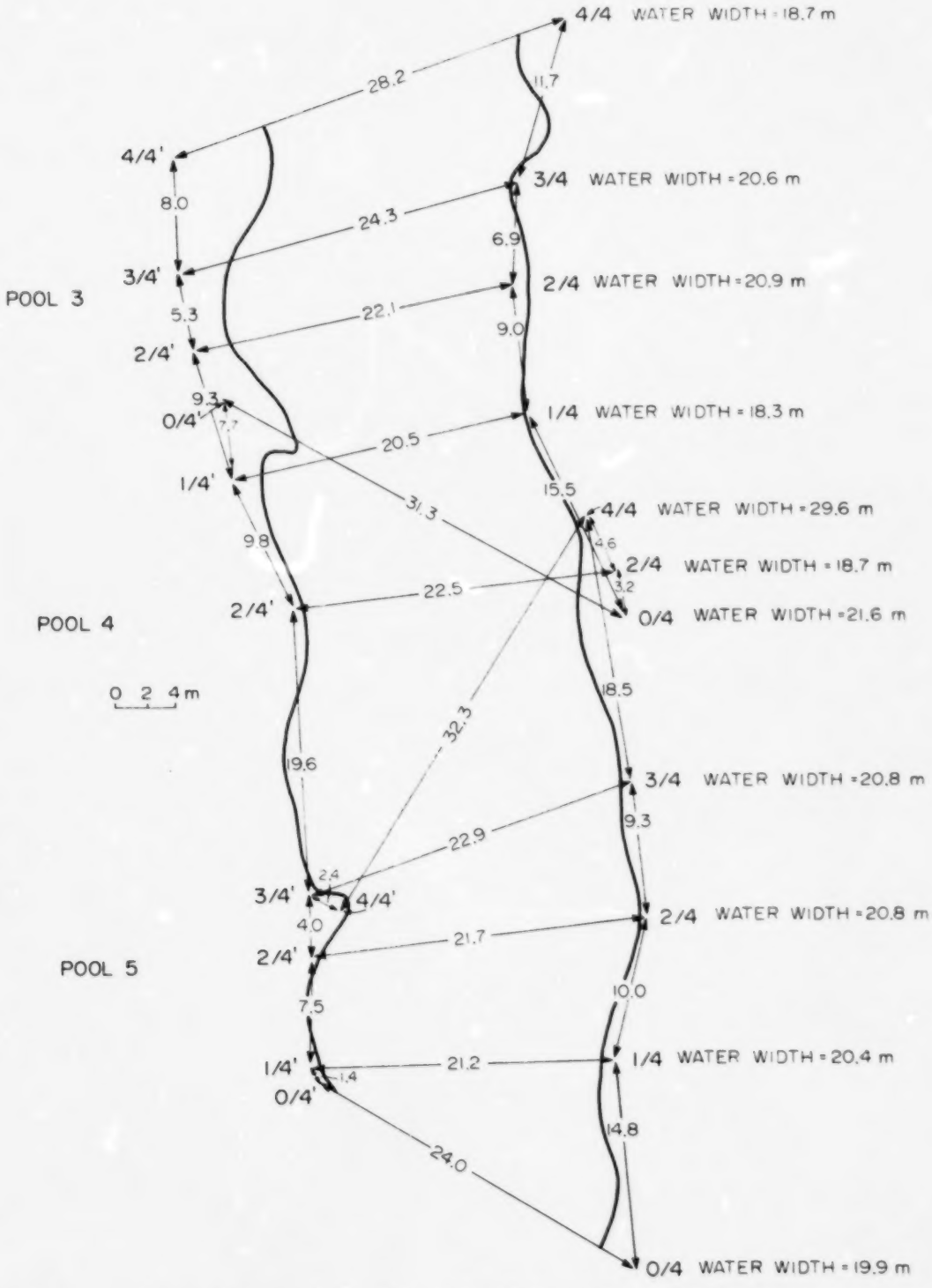

Fig. 3. Kloiya Creek. Map of length of transects and distances between them (m), pools 3, 4 and 5.

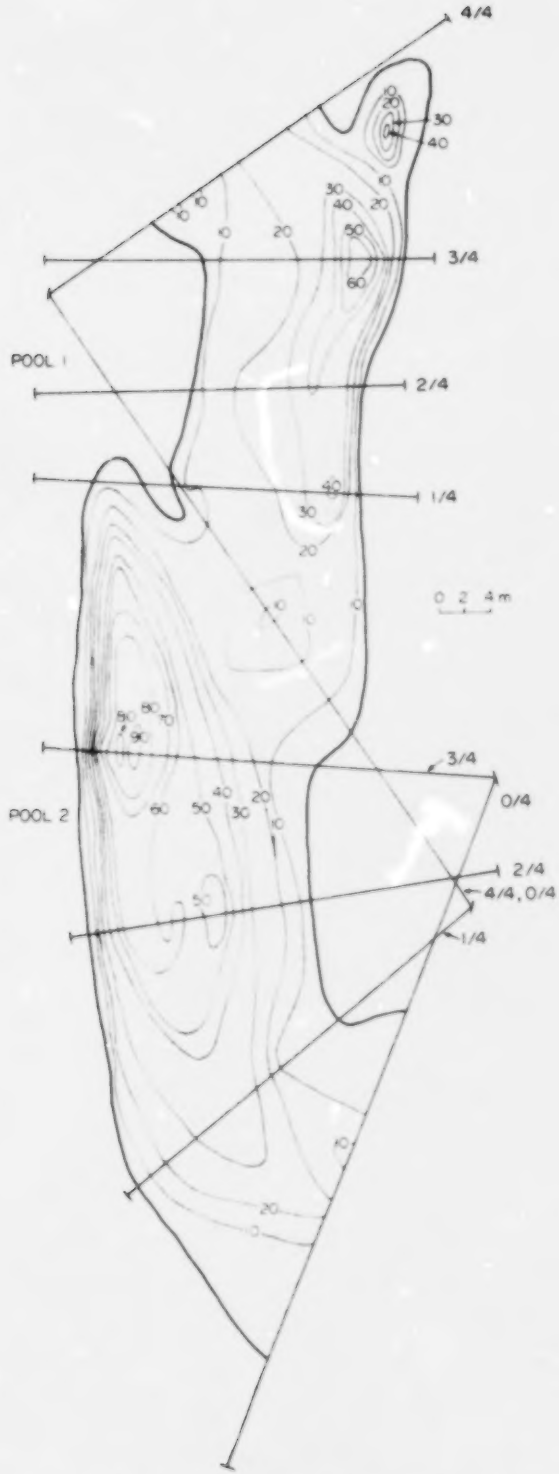

Fig. 4. Kloiya Creek. Map of area of depth intervals (cm) at low flow, pools 1 and 2.

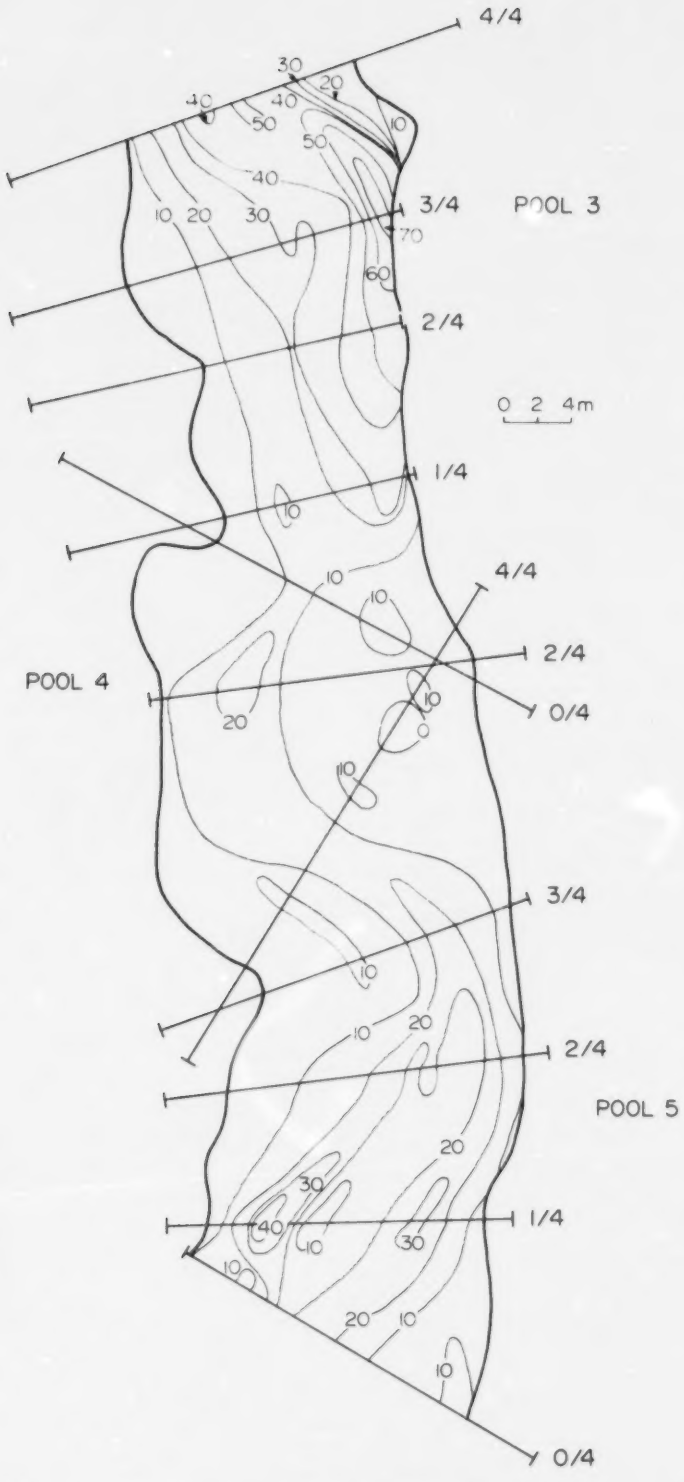

Fig. 5. Kloiya Creek. Map of area of depth intervals (cm) at low flow, pools 3, 4 and 5.

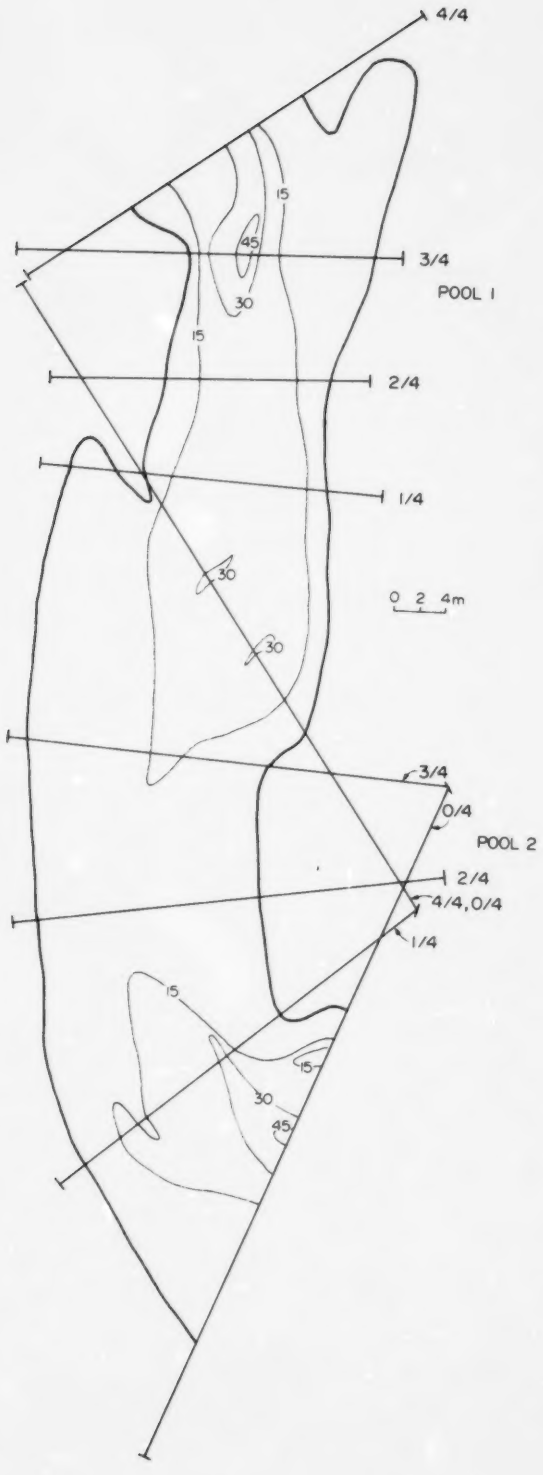

Fig. 6. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 6/10 depth at low flow, pools 1 and 2.

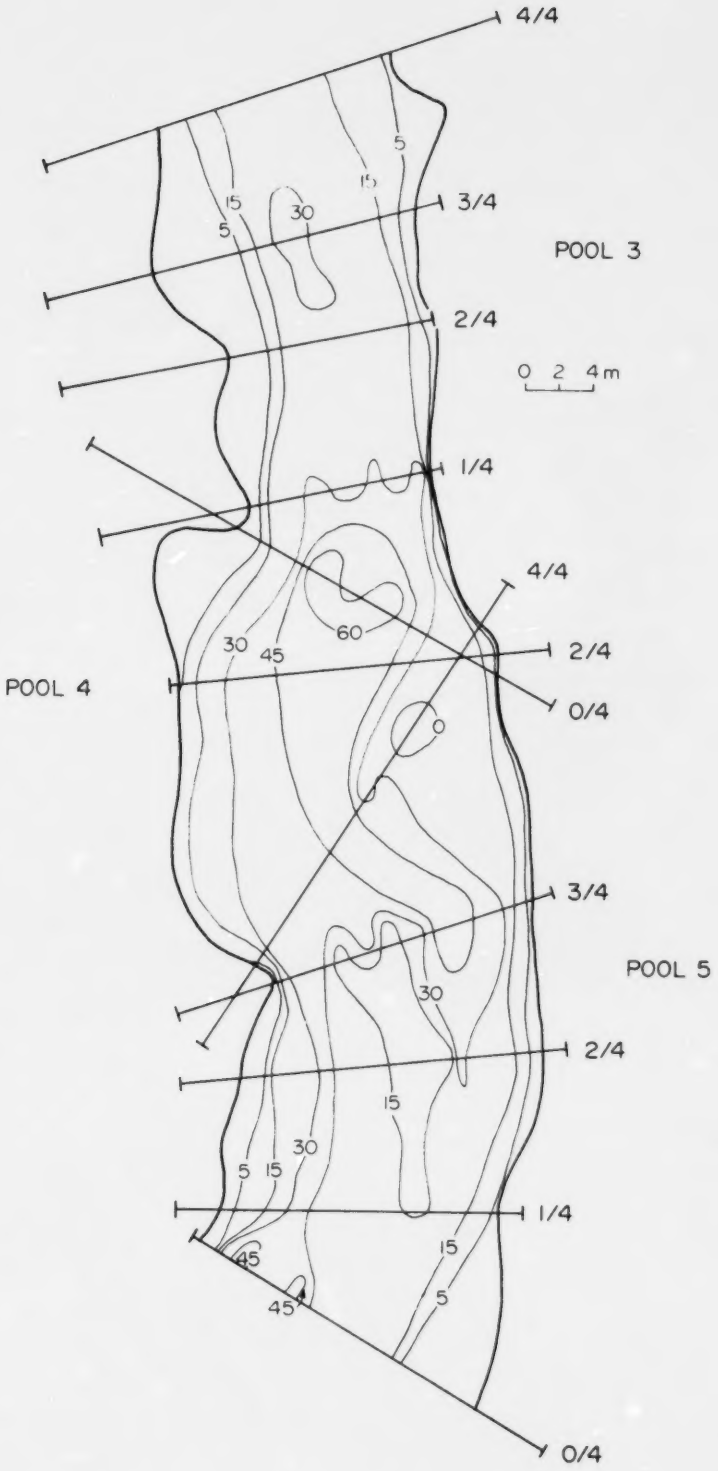

Fig. 7. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 6/10 depth at low flow, pools 3, 4 and 5.

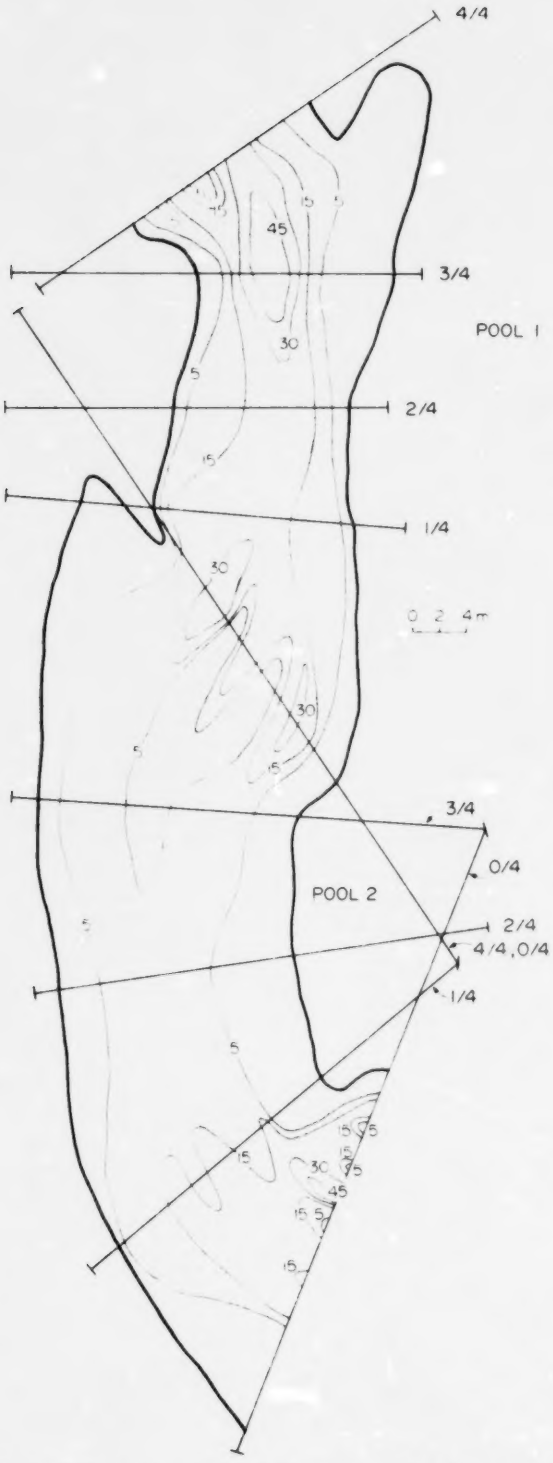

Fig. 8. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at low flow, pools 1 and 2.

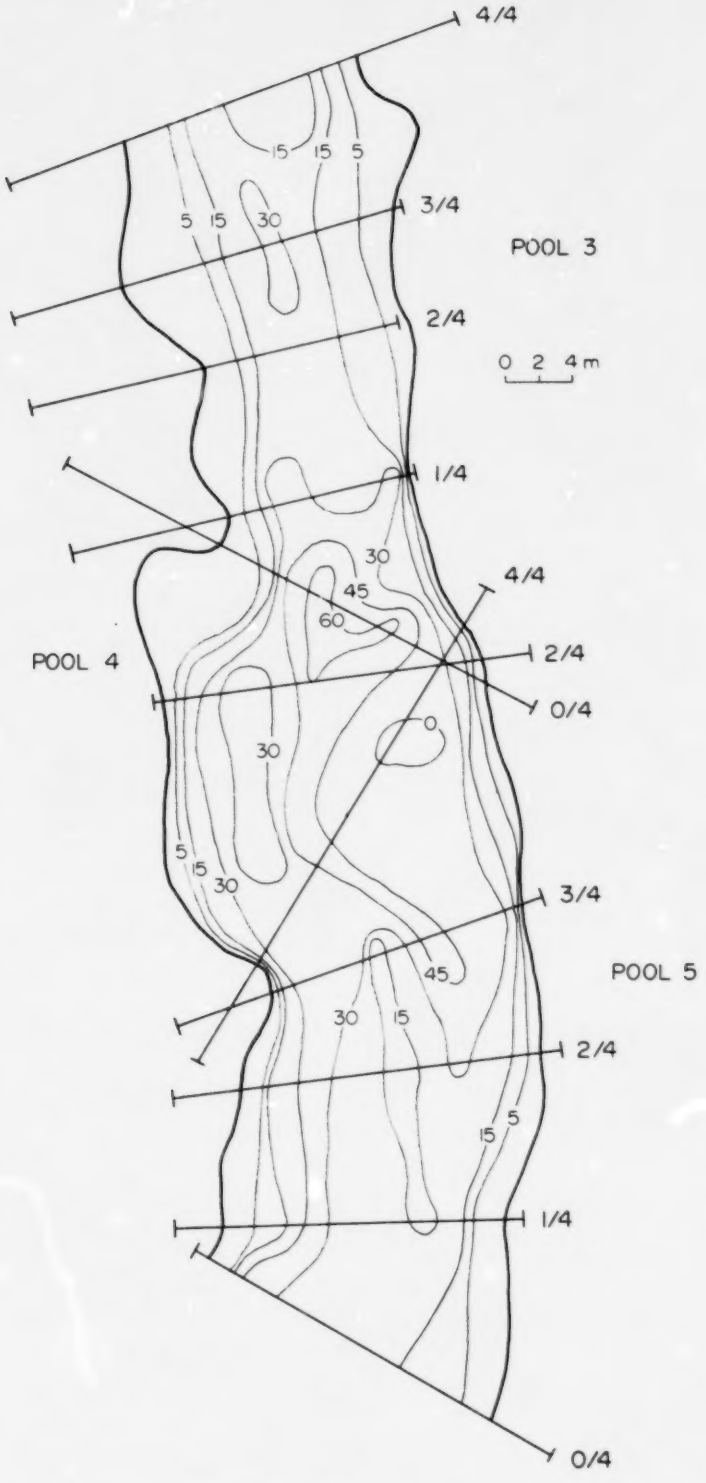

Fig. 9. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at low flow, pools 3, 4 and 5.

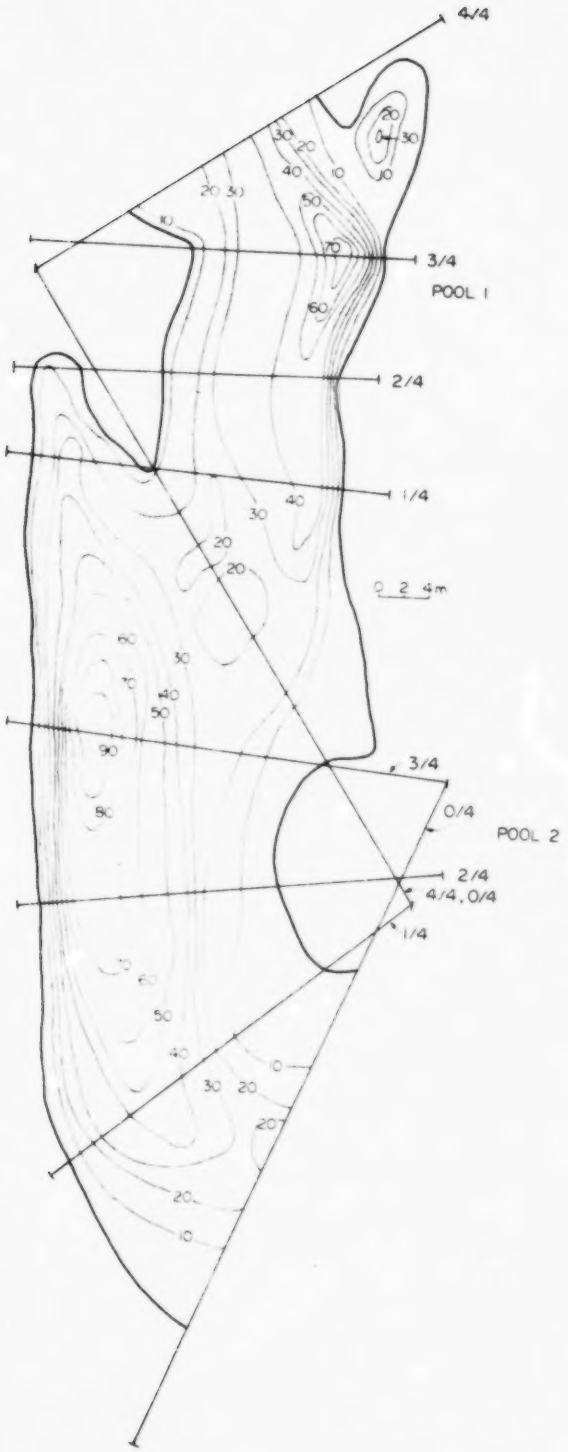

Fig. 10. Kloiya Creek. Map of area of depth intervals (cm) at medium flow, pools 1 and 2.

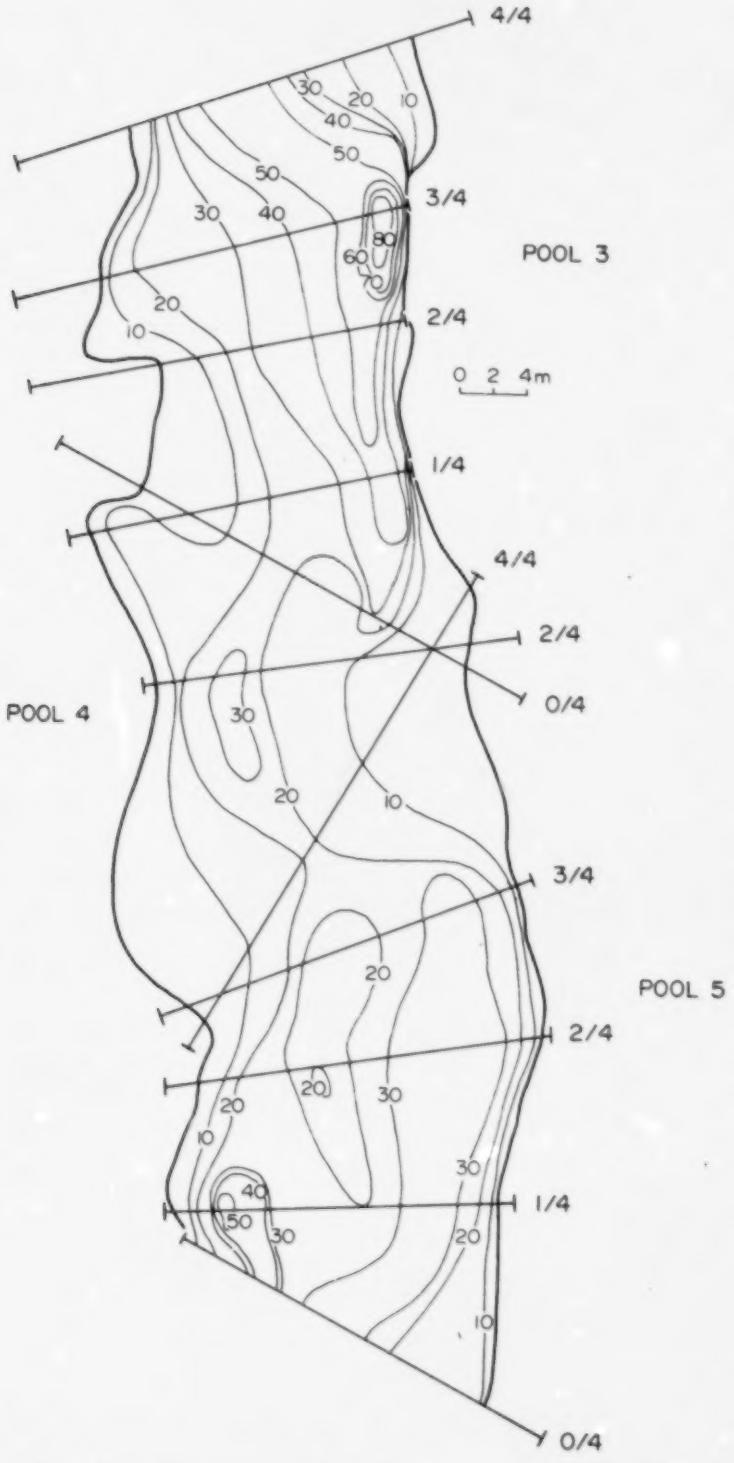

Fig. 11. Kloiya Creek. Map of area of depth intervals (cm) at medium flow, pools 3, 4 and 5.

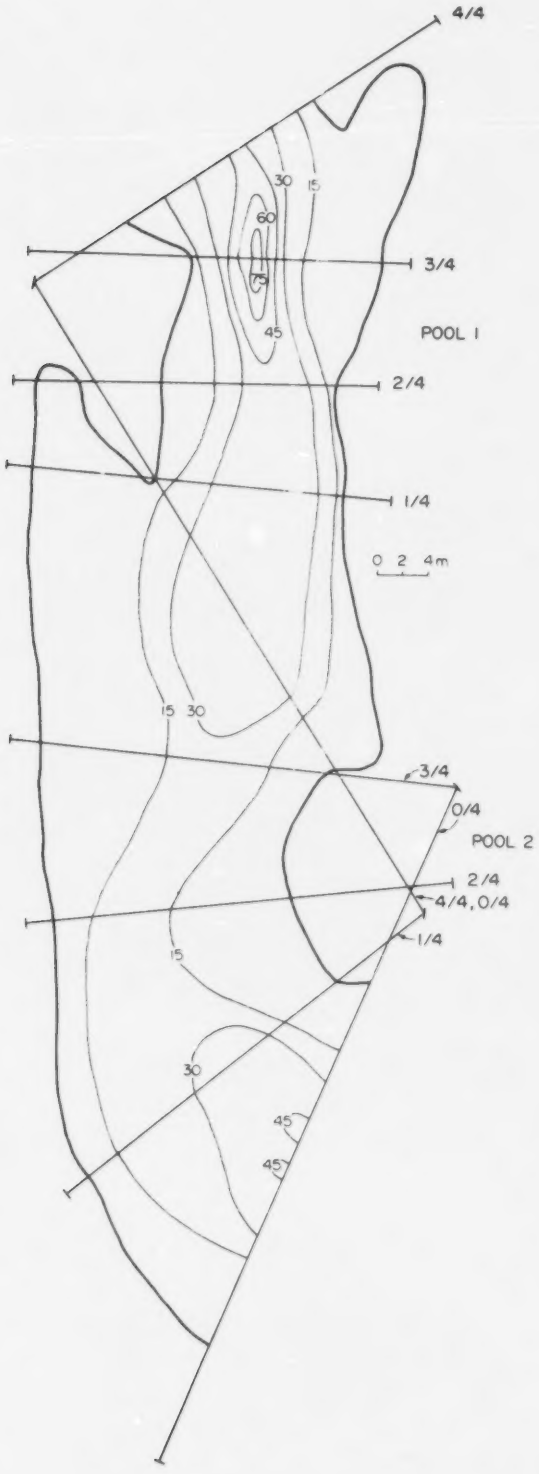

Fig. 12. Kloiya Creek. Map of area of velocity intervals (cm·s-1) at 6/10 depth at medium flow, pools 1 and 2.

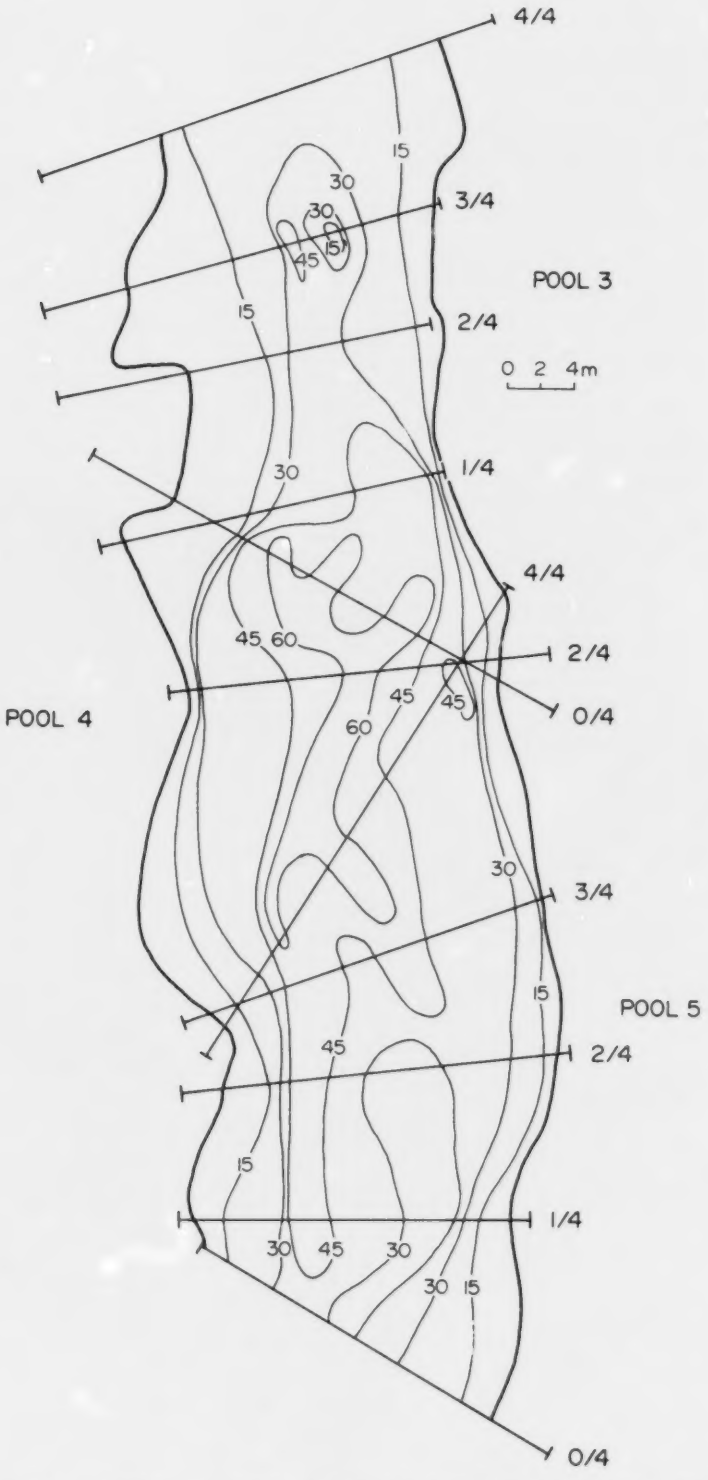

Fig. 13. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 6/10 depth at medium flow, pools 3, 4 and 5.

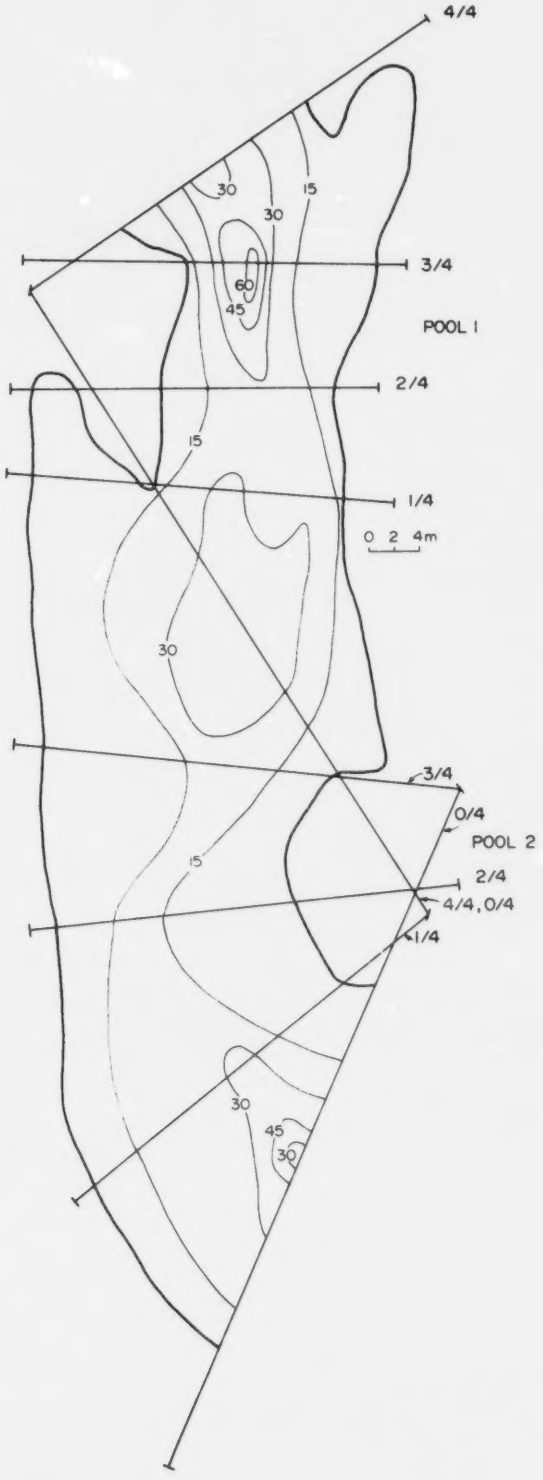

Fig. 14. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at medium flow, pools 1 and 2.

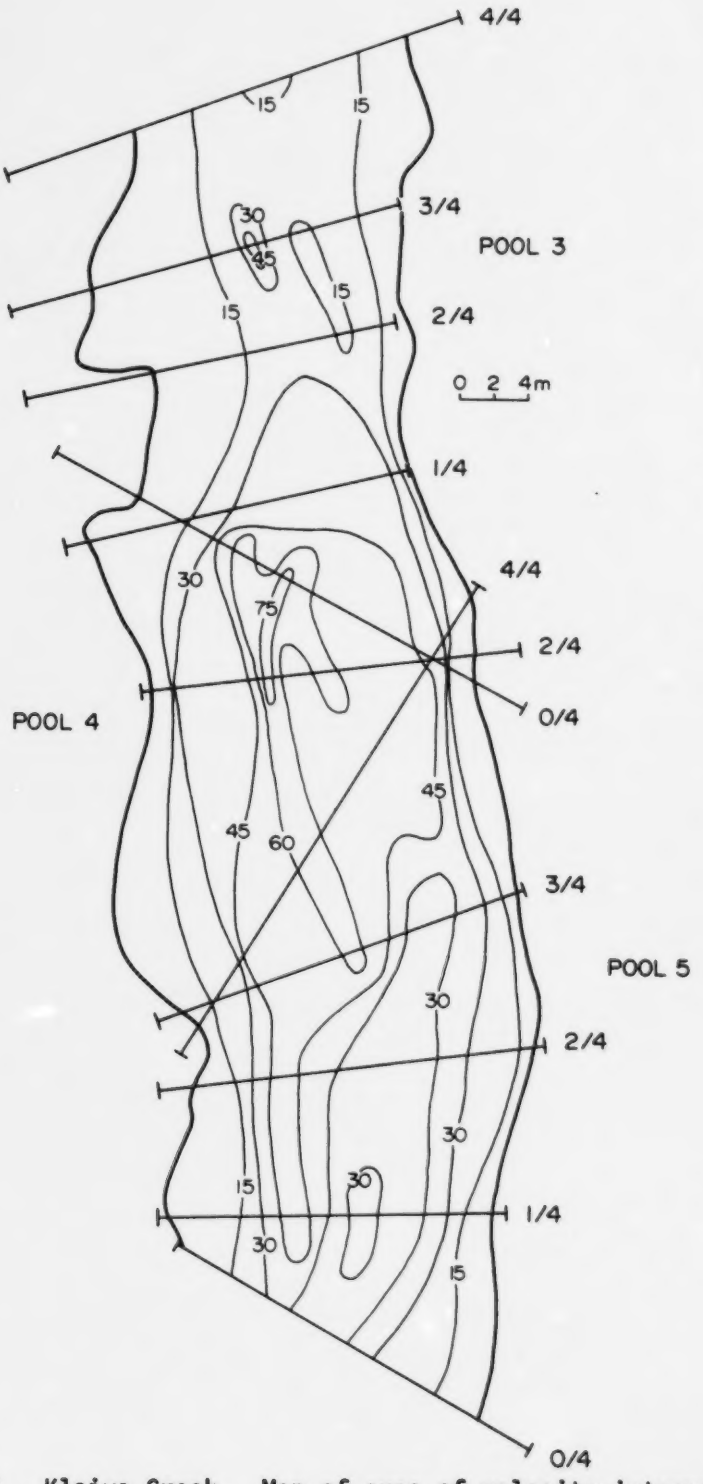

Fig. 15. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at medium flow, pools 3, 4 and 5.

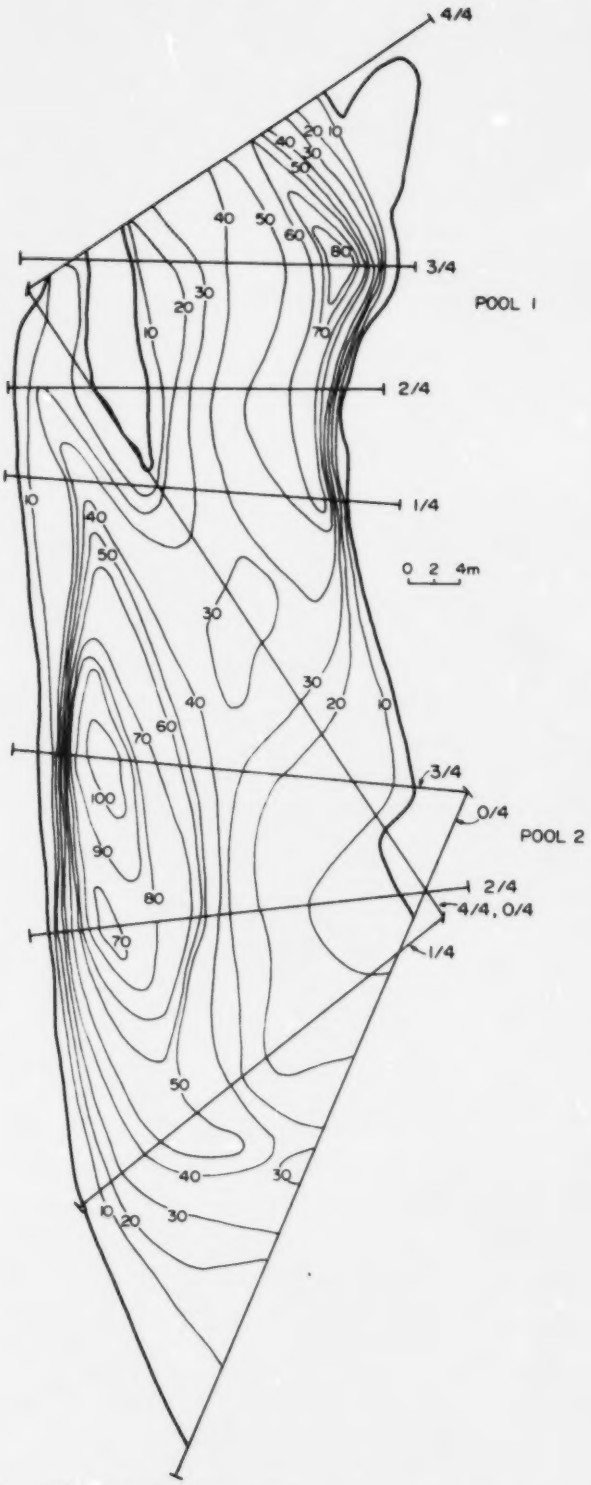

Fig. 16. Kloiya Creek. Map of area of depth intervals (cm) at high flow, pools 1 and 2.

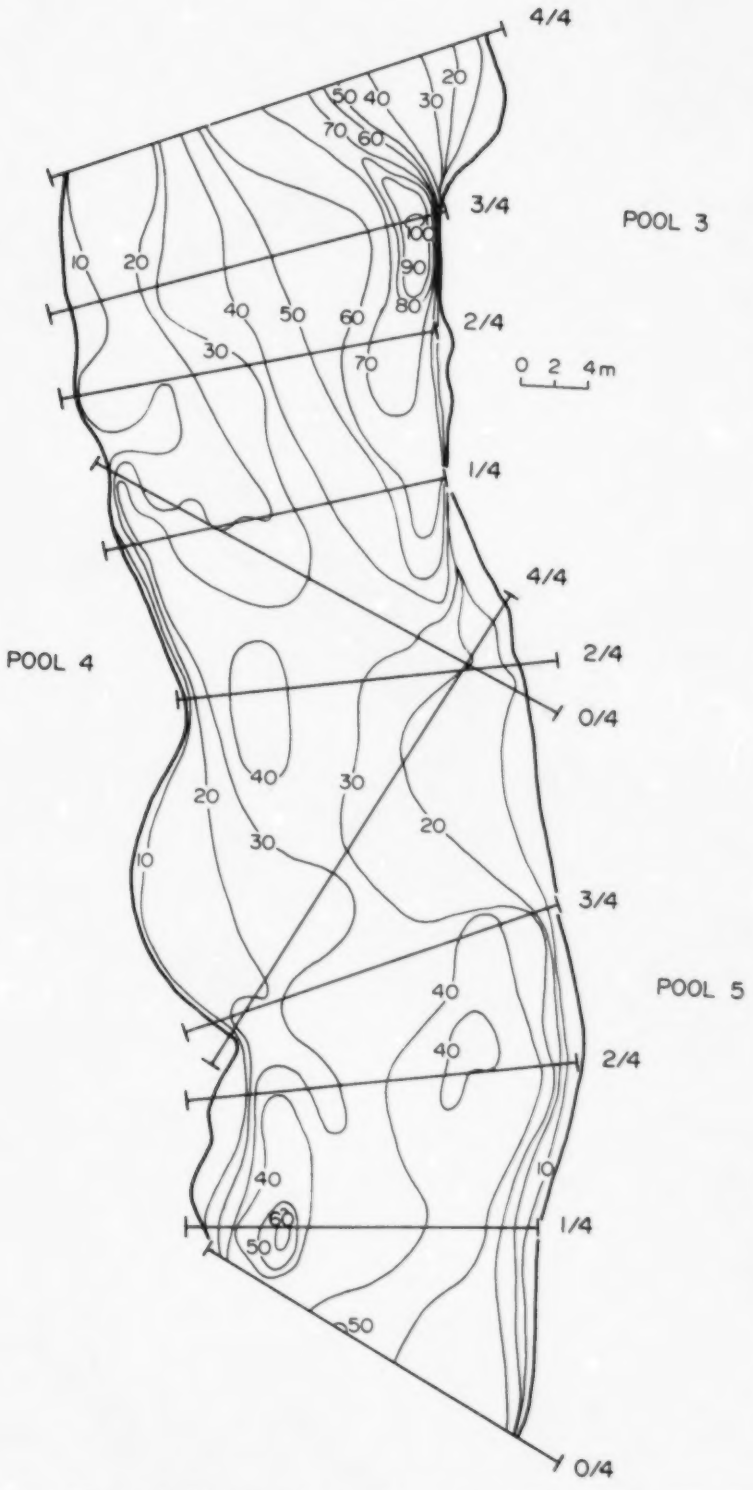

Fig. 17. Kloiya Creek. Map of area of depth intervals (cm) at high flow, pools 3, 4 and 5.

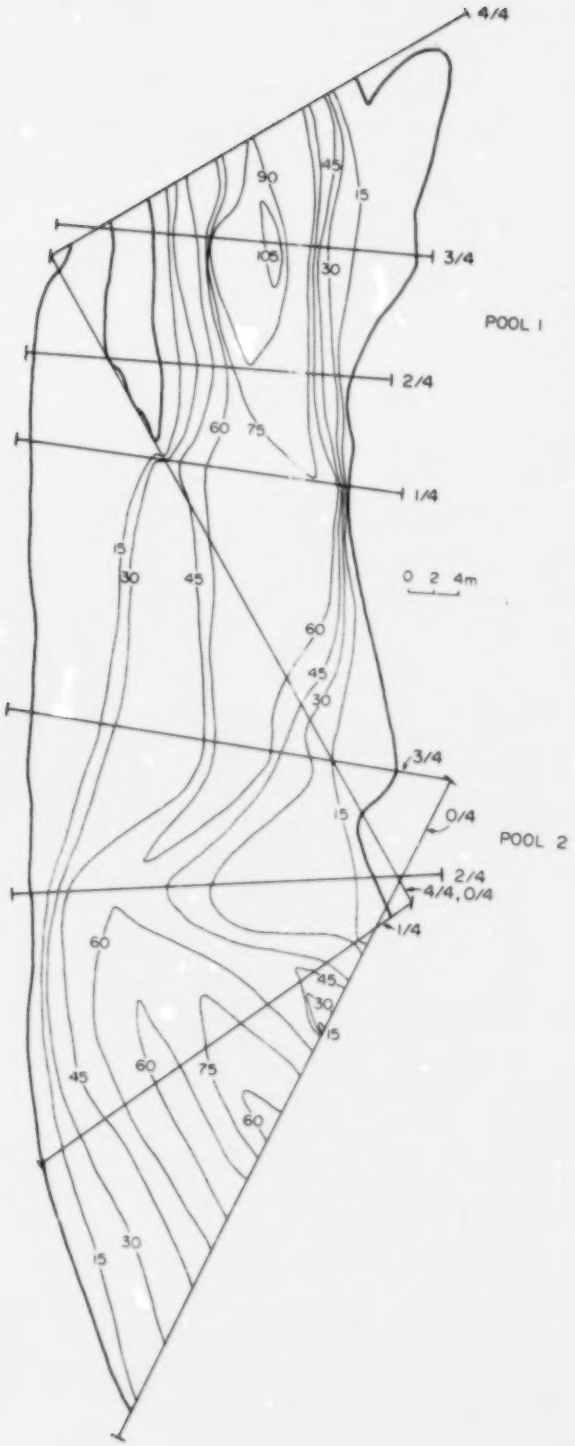

Fig. 18. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 6/10 depth at high flow, pools 1 and 2.

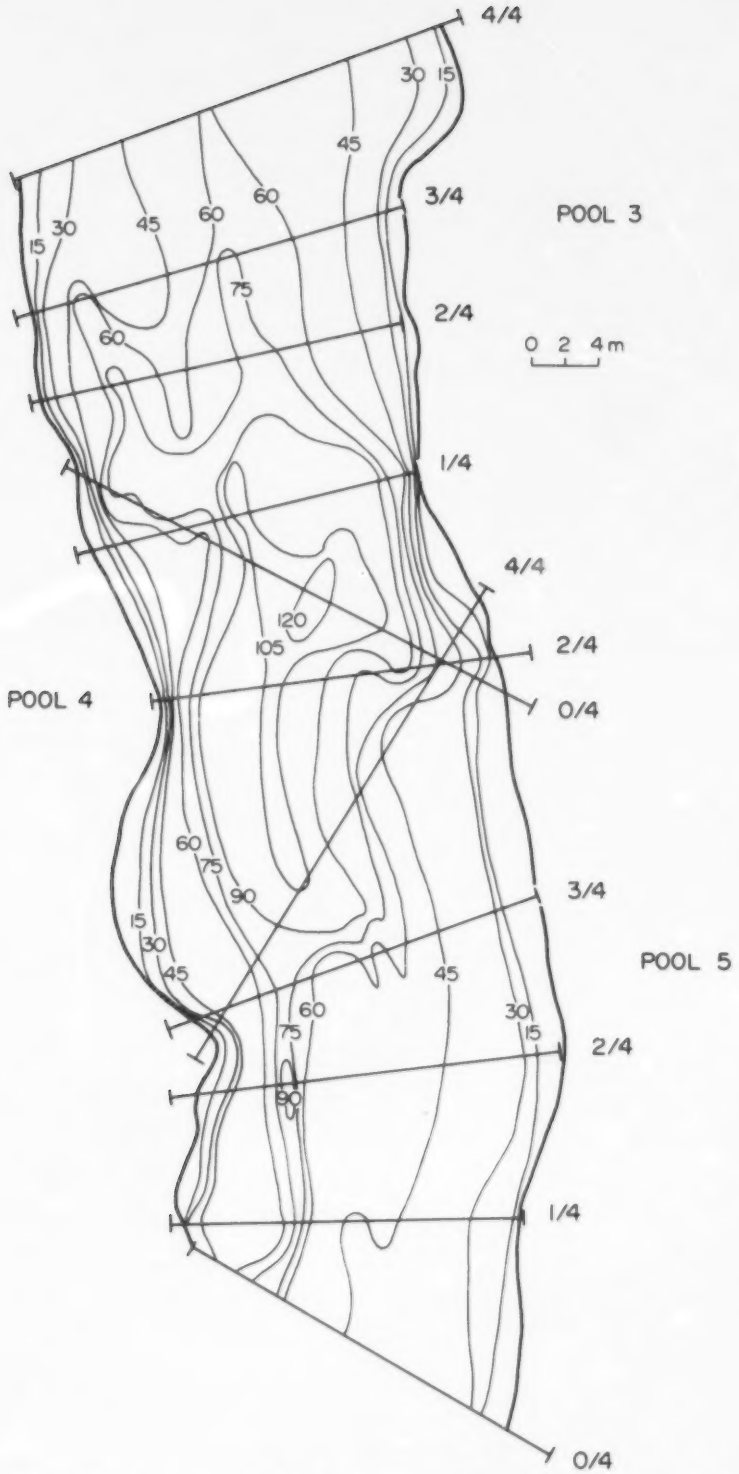

Fig. 19. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 6/10 depth at high flow, pools 3, 4 and 5.

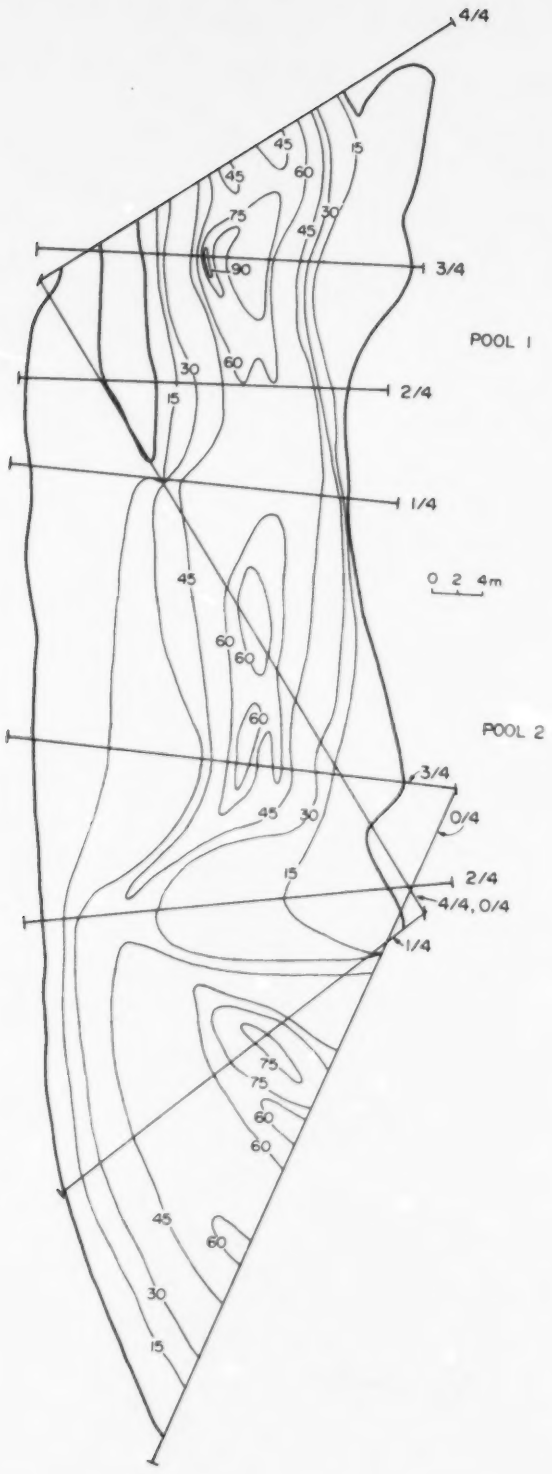

Fig. 20. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at high flow, pools 1 and 2.

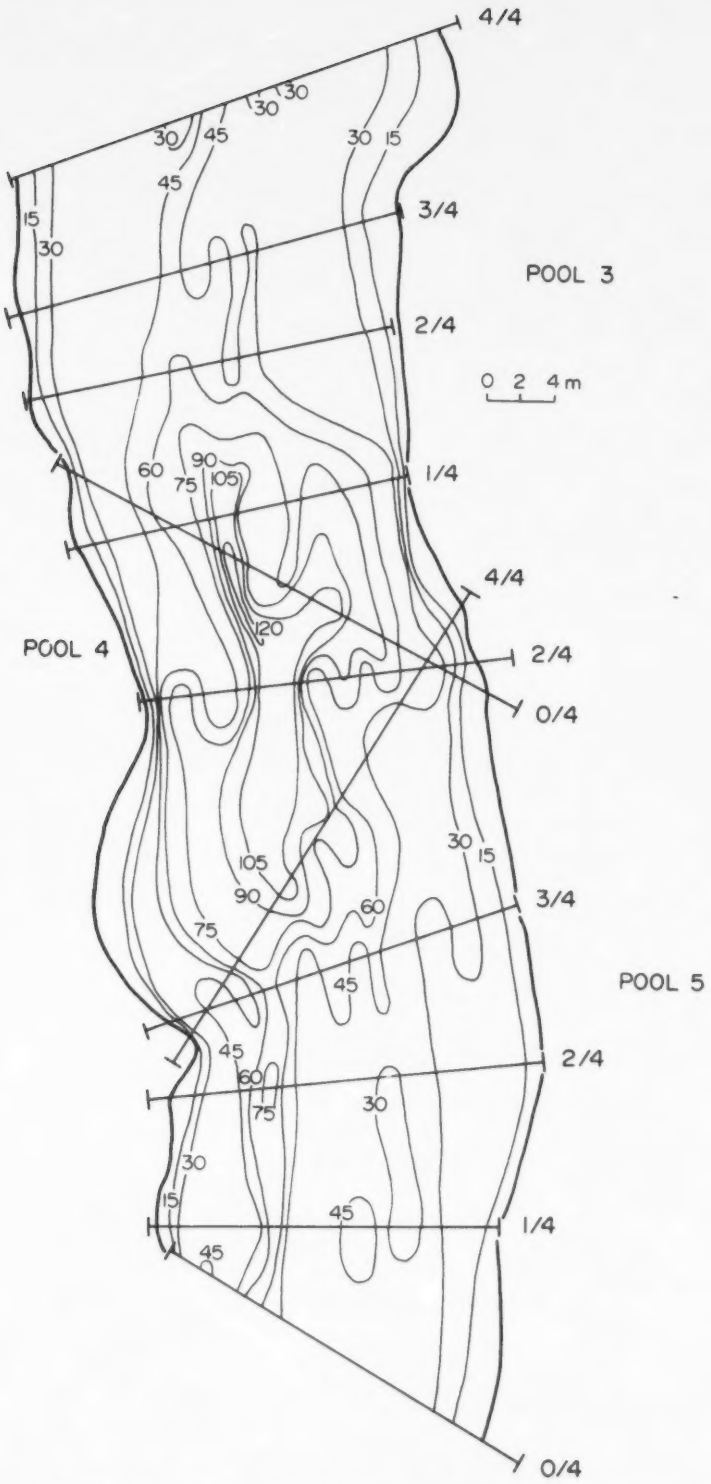

Fig. 21. Kloiya Creek. Map of area of velocity intervals ($cm \cdot s^{-1}$) at 8 cm off the bottom at high flow, pools 3, 4 and 5.

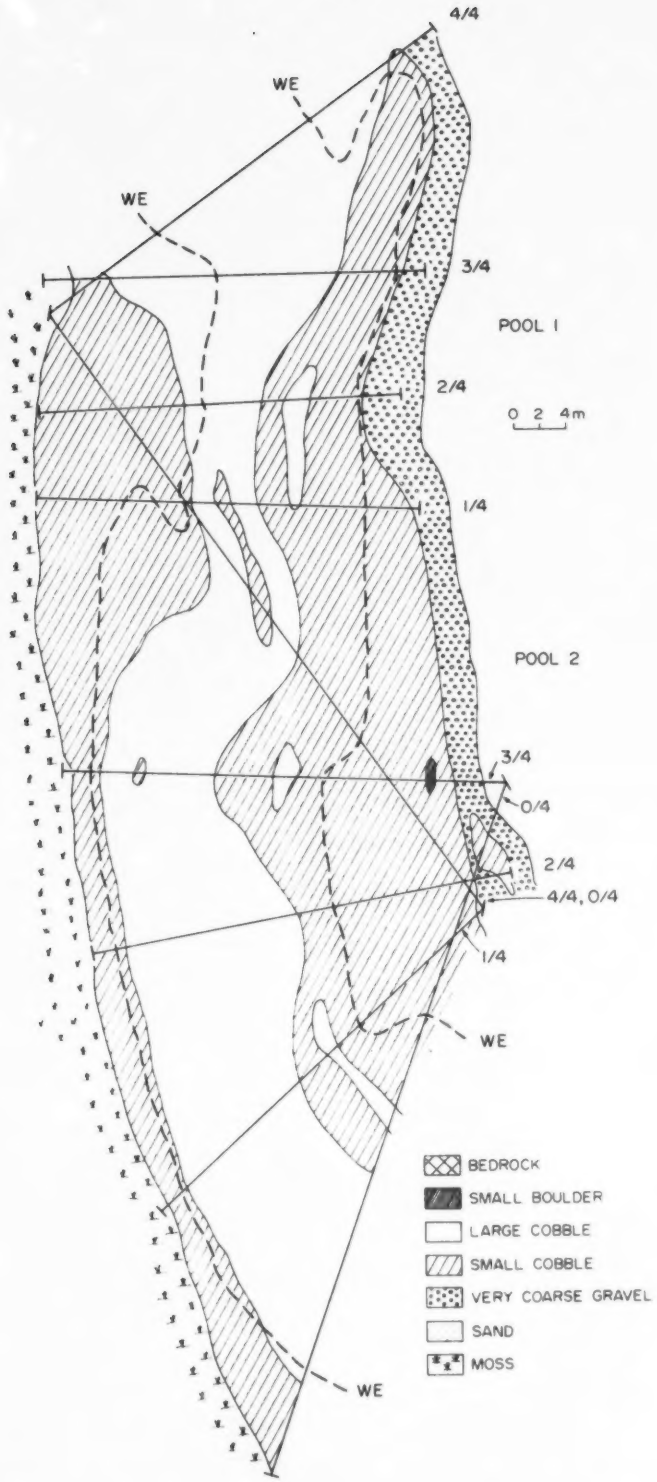

Fig. 22. Kloiya Creek. Map of area of different substrate types at low flow, pools 1 and 2.

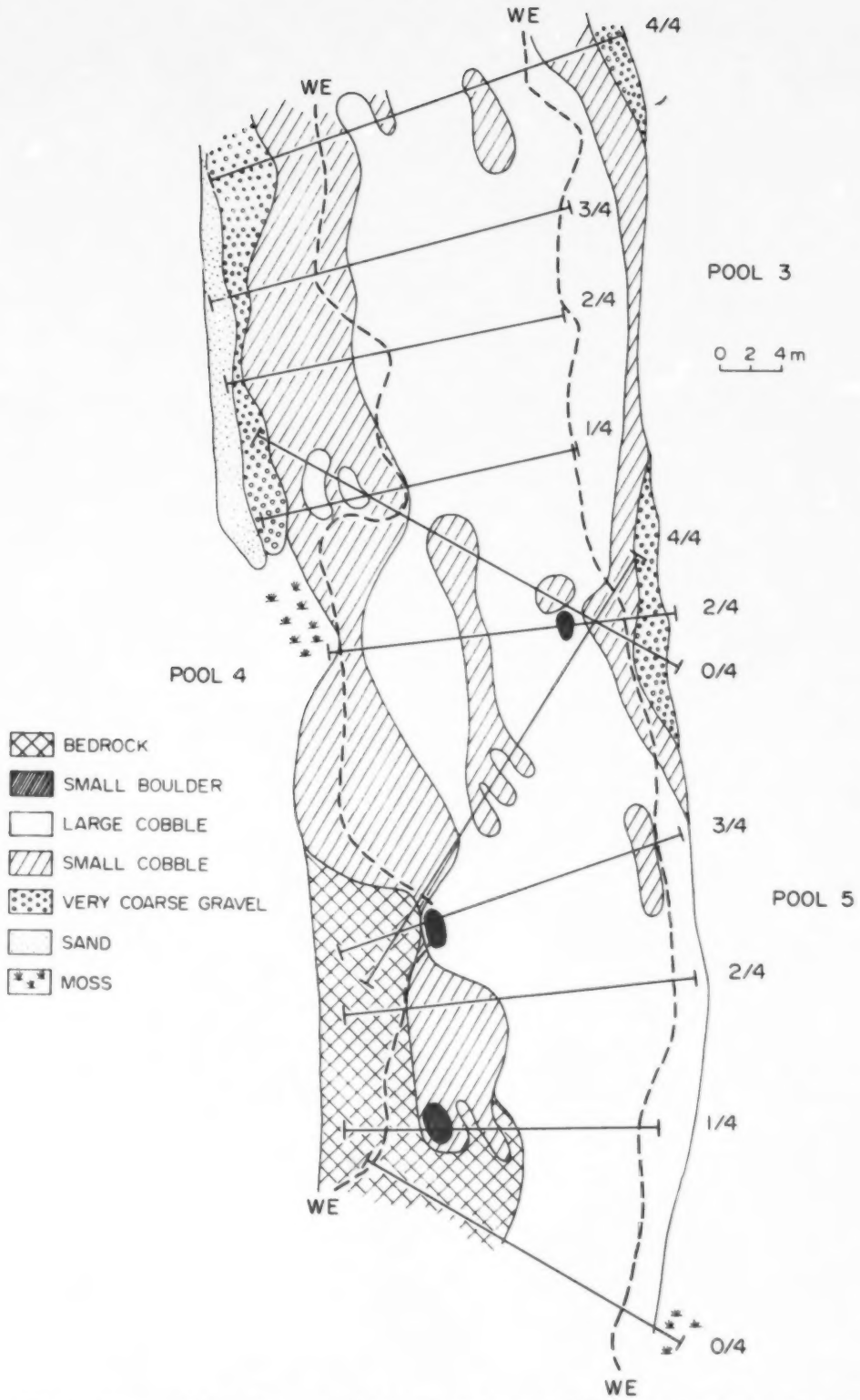

Fig. 23. Kloiya Creek. Map of area of different substrate types at low flow, pools 3, 4 and 5.